INSTRUCTION MANUAL

FOR

REGULATED POWER SUPPLIES

LLS-3000 SERIES

This manual provides instructions intended for the operation of Lambda power supplies, and is not to be reproduced without the written consent of Lambda Electronics. All information contains herein applies to all LLS-3000 series models unless otherwise specified.

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TABLE OF CONTENTS

Section	Page
SPECIFICATIONS AND FEATURES	1
OPERATING INSTRUCTIONS	5
Controls, Fuses and Indicators	5
Connections	6
Basic Modes of Operation and Operating Procedures	7
Operation as a Constant Voltage Source	7
Operation as a Constant Current Source	9
Other Modes of Operation	9
Adjustment of Front Panel Overvoltage Control	10
Operation After Protective Device Shutdown	11
MAINTENANCE	12
General	12
Periodic Maintenance	12
Trouble Analysis	12
Checking Transistors and Capacitors	12
Printed Circuit Board Maintenance Techniques	12
Trouble Chart	13
Performance Checks	17
Power Supply Calibration Procedure	18
Calibration of Output-Voltage-Range Controls R116 and R121	18
Calibration of Output-Current-Range Controls R119 and R128	18
Calibration of Vo (meas) adjust R160	18
Calibration of Io(min) measure R632; and Io(max) measure R634	19
SERVICE	19
PARTS ORDERING	19

SPECIFICATIONS AND FEATURES
(specifications apply for all models)

DC OUTPUT - Voltage and Current regulated for line and load.

TABLE 1

VOLTAGE AND CURRENT RATINGS

MODEL	VOLTAGE (volts)	MAXIMUM CURRENT (AMPS) AT AMBIENT TEMPERATURE		
		40°C	50°C	60°C
LLS-3008	0 to 8	3.5 A	2.95 A	1.75 A
LLS-3018	0 to 18	1.6 A	1.34 A	0.80A
LLS-3040	0 to 40	0.7 A	0.65 A	0.35A
LLS-3060	0 to 60	0.5 A	0.46 A	0.25 A
LLS-3120	0 to 120	0.25 A	0.21 A	0.13 A

Current range must be chosen to suit appropriate ambient temperature.
Current ratings apply for entire voltage range.

REGULATED VOLTAGE OUTPUT

Regulation (line)..... 1mv + 0.01% of Vo(max) for input changes from 85-132 or 170 -265 volts AC.

Regulation (load) ..... 1mv + 0.01% of Vo(max) from 0 to full load.

Ripple and noise ..... 1 millivolts rms, 5 millivolts peak-to-peak on all models.
(20 MHZ measurement bandwidth)

Overshoot ..... No overshoot at turn on, turn off or power failure.

Negative Offset Voltage ..... Power supplies are shipped from the factory with minimum output calibrated to 0+/-10 millivolts.

Temperature Coefficient ..... 0.01% per degree C.

Stability (drift) ..... 0.1% per 8 hour period after 30 minute warm up.

Remote programming
External Resistor..... 200ohm/V nominal in 8 through 60V units
400ohm/V nominal in 120V units.
(Rp terminal to - V).

EGULATED VOLTAGE OUTPUT (Cont'd)

Programming voltage	One to one voltage change (RP terminal to -V).
	Zero to 5 Volt signal from RVP terminal (TB101-2) to common terminal (TB101-6) programs output from 0 to Vo(max). (Common terminal is approximately at the same potential as +v)
Remote Sensing	Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation.

REGULATED CURRENT OUTPUT (AUTOMATIC CROSSOVER):

Regulation (line)	2.5ma or 0.1% Io(max) whichever is greater for input changes from 85 - 132 volts AC or 170-265 volts AC.
Regulation (load)	2.5ma or 0.1% Io(max) whichever is greater for output voltage changes from Vo(max) to short circuit.
Current range	Specifications apply for 1% to full load current.
Voltage range	As shown in Table 1.
Ripple	0.1% Io(max) -rms.
Remote programming	Zero to 5 V signal from RCP terminal (TB101-4) to Common terminal (TB101-6) programs output from 0 to Io(max). (Common terminal is approximately at the same potential as +V.)

AC INPUT

Line voltage	85-132 volts AC (47-440Hz) or 170-265 volts AC (47-440Hz) via rear panel selector switch.
Input power	62 Watts max for LLS-3008 through LLS-3040 models 68 Watts max for LLS-3060 and LLS-3120 models
Input RMS current	1.2 Amperes max. For LLS-3008 and LLS-3018. 1.4 Amperes max. For LLS-3040 through LLS-3120.
Efficiency	44% minimum.
Input surge protection	Meets IEEE 587-1980 for branch circuits and outlets (class A).
Inrush limiting	Power-up inrush current will not exceed 90 Amps peak, at cold start.
EMI	Conducted spectrum conforms with requirements of FCC Docket 20780 Class A (85-132 VAC input) and VDE 0871 Class A (170 - 250 VAC input).

PARALLEL OPERATION - LLS-3000 units of the same rated output voltage can be paralleled in a master/slave arrangement.

SERIES OPERATION - LLS-3000 units of the same rated output voltage can be connected in series with auto-tracking so that both units will track to a common reference.

OVERLOAD PROTECTION

Thermal	Internal temperature sensing circuit monitors operating temperature and will zero output voltage and current if predetermined safe temperature is exceeded. When thermal, or overvoltage shutdown occurs, a front panel fault indicator light will turn on.
Electrical Input	2.5A/250v normal BLO fuse F1 protects AC input circuity.
Output	Automatic constant-current-limiting circuit limits the output current to a customer adjustable value (0% to 102% full load), thereby providing protection for the load as well as the power supply. In addition, there is an internal inverter peak-current-limit circuit which protects the power supply during load transients.

OVERVOLTAGE PROTECTION

All LLS-3000 models include a built-in adjustable overvoltage protection circuit which prevents damage to the load caused by excessive power supply output voltage. Exceeding the overvoltage set point will shut down the unit's operation and cause the front panel fault indicator to light up. AC power must be removed from the unit for approximately 10 seconds to reset the OV shutdown circuit.

Overvoltage Adjustability Range	Model LLS-3008: 4 to 11 VDC.
	Model LLS-3018: 4 to 24 VDC.
	Model LLS-3040: 8 to 50 VDC.
	Model LLS-3060: 8 to 70 VDC.
	Model LLS-3120: 20 to 130 VDC.

REMOTE TURN-ON/TURN-OFF. A TTL low signal (0 to 0.5V), or a short, between Remote on/off terminal (TB101-5) and common terminal (TB101-6) enables the output. A TTL high (2.8 to 5V), or open circuit, between the Remote on/off terminal and the common terminal will bring the output voltage to zero.

COOLING - unit is convection cooled. No fans or blowers required.

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE - Continuous duty from 0 to 60° C ambient with corresponding load current rating for all modes of operation, and appropriate derating.

STORAGE TEMPERATURE (Non-operating) -.55° C to +85° C

INPUT / OUTPUT CONNECTIONS

AC input and line safety ground ..... IEC power line connector (recessed 3-pin male).

DC output ..... Heavy-duty, printed-circuit-board-mounted terminal block at rear of chassis (TB104).

Output ground ..... Screw terminal on rear panel.

DC sensing, remote voltage programming, Remote current programming, Remote on/off, Remote resistance programming, Parallel operation ..... Rear panel, printed-circuit-board mounted, lugless connector (TB101-11 positions.)

CONTROLS

DC output ..... Numerical keypad on front panel allows adjustability of either constant voltage or constant voltage current limit points.Resolution of programmed voltage: 10mV on models LLS-3008 and LLS-3018: 100mV on models LLS-3040, LLS-3060 and LLS-3120. Resolution of programmed current: 10 mA on all models. Accuracy of programmed value versus delivered output:±2% or 3 counts, whichever is greater.

Standby control ..... Allows for zero output without losing last programmed values for voltage and current.

On/off Switch ..... Rocker switch located on front panel.

Overvoltage control ..... Multi-turn, screwdriver-adjust potentiometer located on front panel.

METERS - Front panel 31/2 digit voltmeter and 3 digit ammeter simultaneously monitor output voltage and current. Accuracy of metered value versus delivered output:±2% or 3 counts, whichever is greater.

CONSTANT VOLTAGE/CONSTANT CURRENT INDICATORS - Located on Front Panel. These displays indicate whether power supply is operating as a constant voltage source or is in current limit.

MOUNTING - One mounting surface. Units are shipped with removable rubber mounting feet attached to the unit.

PHYSICAL DATA

Size ..... 4-9/32"x 3-13/16"x10 "

Weight ..... 5.04 lbs., NET; 6.13 lbs shipping

Finish ..... Off white, FED.STD.595, No 26622

ISOLATION RATINGS

Input to output ..... 3000 Volts rms.

Output to ground ..... 500 Volts rms

Input to ground ..... 1500 Volts rms.

WARRANTY - 3 years, parts and labor.

ACCESSORIES

Rack Adapter system..... LRA-15, -17, -18.

Rack Mounting kit

Cable system.
Lambda MATE or GPIB systems
Bench Stand with easy access load terminals

OPERATING INSTRUCTIONS

CONTROLS, FUSES AND INDICATORS

Front Panel On/Off Switch. Located on the front panel is an On/Off switch which controls the application of input power to the supply. The switch disconnects the input circuit from both sides of the AC line in its off position (Labeled "0" on the switch).

Front Panel Programmer. The front panel numerical keypad serves to program both the constant voltage and constant current limit points. Starting with the most significant digit , keying in the desired value followed by an "ENTER" keystroke will institute a new operating limit for either output voltage or current limit, as determined by the programming mode indicators. The programming mode can be switched from voltage to current via the " VOLTAGE /CURRENT" key which functions as a pushbutton toggle.

During a new programming key-in sequence, the front panel digital meter will present the key-in value of voltage or current until the "ENTER" key is depressed. Once this occurs, the meter will revert back to measurement mode and present the output voltage or current delivered by the supply.
In the event of a programming instruction not being followed by an "ENTER" Command, the meter will automatically revert back to measurement mode after approximately ten seconds. The value of the non-entered programming instruction is then lost and any new programming instructions must be started from the most significant digit onwards. At any point during a programming instruction key-in, the meter can be reset back to measurement mode and the programming instruction discarded by depressing the "C/E" key.

If an entered programming instruction is not compatible with the rated putput voltage or current of the power supply, the appropriate meter will display an "Err" message and the program instruction will not be carried out. Depressing the "C/E" key, or waiting approximately ten seconds, will reset the meter back to measurement mode.

At any time during operation of the power supply the programmed value of voltage or current can be displayed by momentarily depressing the "ENTER" key. This will change the appropriate front panel meter, as denoted by the programming mode indicator, to display the last programmed value for voltage or current for a period of approximately two seconds. After this time the meter will automatically revert back to measurement mode. Care should be exercised when performing this check so as not to depress the "ENTER" key for more than one second for this will institute the "Slew Down" function, as described below.

The output voltage or current limit points can be ramped up, or down, by utilizing the "Slew Up" or Slew Down" arrow control. Depressing the "Up" arrow will cause the output voltge or current (as denoted by the programming mode indicator) to ramp up a rate which will increase with the length of time that the key is depressed. Similarly, depressing the "Down" arrow (which also serves as the "ENTER" key) will cause the programmed value for either voltage or current to decrease at a rate which will incraese with the length of time that the key is depressed.

The output voltage of the supply can be brought to zero, without losing the last programmed values of voltage or current (which is the case when power is switched off), by utilizing the "STANDBY" key. Depressing the" STANDBY" key once will bring the output voltage to zero. Depressing the "STANDBY" key a second time reinstate the last programmed values of voltage and current. Programmed values of either voltage or current can be changed while the unit is in standby.

Operating mode indicators. Included on the front panel are a pair of Operating Mode indicators which report on whether the power supply is operating as a constant voltage source, or is in current limit. If the output current of the

pply is below the programmed value for constant current, the operating mode indicator under the voltmeter will minate to indicate that the unit is not in current limit. If the load connected to the supply is of low enough impedance to draw a current which reaches the programmed current limit point, the unit will crossover into constant current and the operating mode indicator under the ammeter will illuminate.

Fault Indicator. Also included on the front panel is a "FAULT" indicator which will illuminate if either an overvoltage or overtemperature shutdown occur. When the fault indicator illuminates, output voltage will zero.

Overvoltage Control. This is a multi-turn, screwdriver-adjust potentiometer located on the front panel. Rotation of this control will vary the overvoltage limit-point from the minimum specified value (fully CCW) to the maximum specified value (fully CW).

Fuse F1 This is a 2.5A/250V Normal-Blo fuse located in series with the AC line. This fuse protect the power supply from excessive overcurrents in the event of an internal component failure. NOTE: POWER MUST BE REMOVED FROM THE UNIT BEFORE CHECKING OR REPLACING THIS FUSE.

Line Select Switch S101. This is a screwdriver actuated switch which is accessible through a hole in the rear of the unit. Selection of input voltage range (85-132 or 170-265 VAC) should only be performed with AC power removed from unit.

CONNECTIONS

AC Input. AC input connection should be made using an IEC type, three-prong female connector. An IEC line cord is supplied with the unit.

DC Output. Load connections must be made to two-position terminal block TB104. This block is designed to handle the maximum current and voltage attainable from the supply and will accept a No. 6 Ring or Spade-type lug.

nsing. Terminals for sensing output voltage are located on TB101, and are terminals 10 and 11.
ocal sensing can be achieved by strapping terminal 10 to + V terminal and terminal 11 to -V terminal See figure 3.

Remote Voltage Programming, Remote Current Programming, Remote On/Off, Remote Resistance Programming, Parallel Operation, Terminals for achieving these functions are located on TB101, pins 1 through 9. See Modes of operation and Operating procedures for details. TB101 is a lugless-type connector which will accept up to an AWG No. 20 stripped wire. Shipped with the unit are a number of ring type solder lugs which can be utilized if multiple wires are to be connected to TB101 positions .

Load Ground Connection. This power supply can be operated with either the positive or negative terminal grounded, or with neither terminal grounded. A screw terminal in the chassis at the rear of the unit is provided for grounding one of the output terminals, if desired.

NOTE: When operating the supply with neither output terminal grounded, high impedance leaking resistance and capacitance paths can exist between the power supply circuitry and chassis ground.

BASIC MODES OF OPERATION AND OPERATING PROCEDURES

This power supply is designed to operate as a constant-voltage source or as a constant-current source. Automatic crossover to either mode of operation occurs when load conditions change as follows:

Constant Voltage. The power supply will function as a constant-voltage source while the load current is less than the current value I_{LIM} as set by the front panel current -limit programming generator, or where applicable, by the external current programming signal applied to the RCP terminal. When the load current $I_L(=Vo/R_L)$ reaches I_{LIM}, the supply will crossover automatically and will operate as a constant current source. Further decrease in the value of the load resistor will result in a decrease of voltage across the load while the current remains regulated to I_{LIM}

Constant Current. The power supply will function as a constant-current source while the load voltage V_L does not exceed the the voltage value set by the front panel constant voltage programming generator, or, where applicable, by the external programming signal applied to either the RVP terminal or the Rp terminal When the load resistance is high enough so that the load voltage
Vo(=I_LxR_L) reaches the value set by the programming controls, the supply will automatically crossover and operate as a constant voltage source.

Power Up and Front Panel Initial Settings. Upon initiation of AC power, the front panel constant voltage and constant current generators will be present to deliver zero output voltage along with a current limit corresponding to the 40°C rating of the supply, plus 2%. Immediately following power on, the front panel meters will display these programmed values for approximately two seconds before revertimg to measurement mode.

To deliver voltage after power up, the desired operating voltage must be entered through the numeric keypad, or the "Slew Up" arrow can be utilized. It should be noted that when the power supply is switched off via the front panel switch, the last entered programming values of voltage and current will be lost. When the power supply is switched back on again, it will power up as described above. If an application requires that power be interrupted to a load, and a quick return to the pre-existing programmed values of voltage and current is desired, the front panel "STANDBY" control can be utilized.

OPERATION AS A CONSTANT-VOLTAGE SOURCE

The output impedance and regulation of the power supply at the load may change when using the supply as a constant-voltage source and connecting leads of practical length are used. To minimize the effect of the output leads on these characteristics, remote sensing can be used. Recommended types of supply-load connections, with local or remote sensing, are described in the following paragraphs.

Local Sensing Connection, Figure 3. Local sensing is the connection suitable for applications with relatively constant load where extremely close load regulation over the full rated current excursion is not required at the load.

Remote Sensing Connection, Figure 4. Remote sensing provides complete compensation for the DC voltage drop in the connecting cables. Sensing leads should be a twisted pair to minimize AC pickup. A 2.5UF capacitor may be required between the output terminals and sense terminals to reduce noise pick-up.

SAFETY NOTICE

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT. OBSERVE THE USUAL SAFETY PRECAUTIONS WHEN OPERATING OR SERVICING THE EQUIPMENT TO AVOID SHOCK OR INJURY.

CONSTANT-VOLTAGE OPERATION, INTERNAL PROGRAMMING, ADJUSTABLE CURRENT LIMIT.

When shipped from the factory, the supply is ready for use as a constant-voltage/constant-current source with automatic crossover. Initial programmed points for constant voltage and constant-current are as described in the previous text. Jumpers are in place for local voltage sensing, figure 3. If remote-sensing connection is desired, the load should be

wired as shown in figure 4. It should be noted the front panel voltmeter measures the voltage at the rear panel power terminals and may not accurately reflect voltage at the load in remote sense applications.

Determine load requirements and select wire size from figures 1 and 2.

After applying input power, output voltage can be adjusted to any desired value via the front panel numerical keypad programmer. The current-limit point can be adjusted by setting the "PROGRAM MODE" indicator to "AMPS" via the "VOLTAGE/CURRENT "key and then keying in the desire current limit value, followed by an "ENTER" keystroke.

Programmed Constant-Voltage Operation Using a Zero to 5-Volt External Source. The power supply output voltage can be programmed via an external zero to 5-volt source by utilizing the RVP terminal on TB101. The jumper between terminals TB101-1 and-2 should be removed and the external source connected between terminals TB101-2 and-6 (figure 5). Please note that the common terminal is at approximatetly the same potential as the +V terminal. The constant-voltage operating point will be directly proportional to the external voltage, with zero output voltage corresponding to zero programming and rated output voltage + 2% corresponding to 5 volts programming. Remote versus local sensing and current limit set point adjustment are explained in the preceding text.

Programmed Constant-Voltage Operation Using An External Resistor. The power supply output voltage can be programmed via an external resistor by utilizing the Rp terminal on TB101. The external resistor should be connected between TB101 terminal 9 and -V, while the -S terminal (TB101 terminal 11) is not connected (figure 6).

The value of the external resistor can be chosen to be any value from 200 ohms per volt (nominal) to1000 ohms per volt nominal) by presetting the voltage from RVP terminal TB 101-2 to common terminal TB101-6 via the front panel pro (grammer. A 5-volt potential between these terminals corresponds to 200 ohms per volt (nominal) and can be achieved by programming the front panel to full scale voltage (Vo(RATED) +2%). A 1- volt potential between these terminals corresponds to 1000 ohms per voltage (nominal) and can be achieved by programming the front panel in 20.4% of the rated voltage.

It should be noted that this programmed value must be re-entered every time AC power is applied to the power supply.

Programmed Constant Voltage Operation Using a One-To-One External Voltage Source Referenced to -V.
The power supply output voltage can be programmed via an external one-to-one voltage by utilizing the Rp terminal on TB101. The external voltage source should be connected betwenn Rp terminal (TB101-9) and -V, while leaving -S terminal (TB101-11) disconnected (figure 7.) In addition terminals 1 and 2 should be open circuited.

The external source should be current limited to no more than 10 mA in order to protect internal components in the LLS units.

Remote versus local sensing and current-limit-set-point adjusment are as described above under Constant Voltage operating procedure.

OPERATION AS A CONSTANT-CURRENT SOURCE

In this mode of operation, when the load voltage increases, due to changing load resistance, to the limit of the front panel constant voltage setting, the power supply crossover circuit will cause the unit to operate as a constant-voltage supply.

SAFETY NOTICE

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT. OBSERVE THE USUAL SAFETY PRECAUTIONS WHEN OPERATING OR SERVICING THE EQUIPMENT TO AVOID SHOCK OR INJURY.

Constant-Current Operation, Internal Programming, Adjustable Voltage Limit. When shipped from the factory, the supply is ready for use as a constant-voltage/constant-current source with automatic crossover. Initial programmed points at power up for constant voltage and constant current are as described in the previous text.

Determine load requirements and select wire size from figures 1 and 2.

After applying power, output current and maximum voltage limit point can be adjusted to any desired value via the front panel numerical keypad.

Programmed Constant-Curent Operations Using a Zero-to-5-Volt External Source. The power supply output current-limit can be programmed via an external zero-to-5-volt source by utilizing the RCP terminal on TB101. The jumper between terminals TB101-3 and -4 should be removed and the external source should be connected between terminals TB101-4 and -6 (figure 8). It should be noted that the common terminal is at approximately the same potential as the +V terminal. The constant current operating point will be directly proportional to the external voltage, with zero output corresponding to zero programming and full-rated output-current(at 40^{o} C) + 2% corresponding to 5 volts programming. Maximum voltage-limit set-point is as described above.

OTHER MODES OF OPERATION

TTL Compatible Remote Turn-On/Turn-Off. A TTL compatible remote turn-on/turn-off function is available by utilizing terminal 5 of TB101. A TTL low signal (0 to 0.5 Volts) or a short between terminal 5 and terminal 6 of TB101 enables the output voltage. A TTL high (2.8 to 5 Volts), or open circuit between terminal 5 and terminal 6 of TB101 will cause the output voltage to go to zero, see figure 9. It should be noted that terminal 6 (common) is at approximately the same voltage potential as +V, thus any TTL signal must be floated on top of +V.

Parallel Operation. The output current capability of LLS-3000 power supplies can be increased by connecting supplies of the same output voltage rating in parallel. The supplies can be operated in a MASTER/SLAVE configuration by using the circuit shown in figure 10. The connection between -S terminal (TB101-11) and -V terminal must be removed, and a connection must be added from terminal TB101-6 of the MASTER unit to terminal TB101-9 of the SLAVE unit. In addition, a jumper should be added between TB101 terminals 6 and 10 of the SLAVE unit. Note that constant current specifications do not apply in parallel operation.

Series Operation. The voltage capability of LLS-3000 power supplies can be extended by series operation of two power supplies of equal voltage ratings. A maximum of 500 volts can be connected between either the +V or -V terminal and chassis ground. Figure 11 shows the connection for the series operation.

Diodes CRA and CRB, which protect the units from carrying excesive current in the event of a unit not being powered up, must be capable of withstanding the maximum rated-current.

For master/slave operation with auto tracking, TB101 terminals 1 and 2 of the slave unit are disconnected from one another. Also, an external resistor, Rx, is connected from terminal TB 101-1 of the master unit to terminal TB101-9 of the slave unit. The value of Rx is 1600 ohms for model LLS-3008, 3600 ohms for model LLS-3018, 8000 ohms for model LLS-3040, 12000 ohms for model LLS-3060 and 45,000 ohms for model LLS-3120. Due to the existence of certain tolerances, the value of Rx required for perfect tracking may vary slightly from the nominal values given here. In Series Operation. The voltage capability of LLS-3000 power supplies can be extended by series operation of two power supplies of equal voltage ratings. A maximum of 500 volts can be connected between either the +V or -V terminal and chassis ground. Figure 11 shows the connection for the series operation.

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Utilization of Remote Features and Implications on Output Noise. When various remote features of the power supply are utilized (such as remote voltage programming, remote current programming, remote TTL compatible on/off or remote resistance programming), or when power supplies are utilized in parallel or series combinations, output ripple and noise may be slightly degraded due to high-frequency spikes caused by noise radiated through wires connected to terminals 1 through 9.
Normally, the amplitude and spectral content of these spikes is such that a small decouping capacitor connected at the remote load-distribution-point will adequately attenuate any noise pickup. However, in extremely sensitive applications, where spikes cannot be tolerated, radiated noise emanating from wires connected to terminals 1 through 9 can be minimized by utilizing high-frequency-rated ferrite noise suppressors on each of the externally connected signal wires. In order to be effective, these noise suppressors must be physically located on the signal wire at a point no further than 3 inches from where the wire connects to the power supply terminals. These noise suppressors can either be obtained from your local Lambda sales office or by contacting the factory. Figures 15 and 16 detail the use of these noise suppressors.

ADJUSTMENT OF OVERVOLTAGE CONTROL R156.

The overvoltage protection circuit provides an adjustable means of shutting down the power supply if the output voltage exceeds a pre-determined safe value.
Exceeding the O.V point will zero output voltage and current and a front panel indicator light will turn on to indicate a fault condition . Once the cause of the overvoltage has been determined and removed, the shutdown circuit can be reset by removing AC power to the unit via the front panel ON/OFF switch for approximately 10 seconds.
The procedure for setting the overvoltage control is as follows:

(The power supply should be removed from associated equipment, be at an ambient temperature of 25-30^{o} C and operated at nominal line voltage.)

1. The recommended voltage protection point is 115% of the selected power supply operating voltage or 1.5 volts above the selected operating voltage, whichever is greater. (If set too low, load off transients may cause the overvoltage protection circuit to trip.)

2. Turn the OV adjust control fully clockwise.

3. Apply AC power to the unit and adjust the output voltage to the desired protection point. If the power supply does not have adequate output range to reach this point omit steps 4 and 5, and proceed to step 6.

4. Slowly rotate the OV adjust control CCW while monitoring the front panel display. When the front panel voltmeter read-out sharply drops and the front panel indicator light comes on, the OV shutdown point has been reached.

5. The voltage protection point is now set. Turn the unit off for approximately 10 seconds to reset the shutdown circuit. When power is switched back on, the initial programmed points for voltage and current will be as described under POWER UP and FRONT PANEL INITIAL SETTINGS.

6. If the power supply adjustment range is not adequate to reach the desired OV protection point, proceed as follows:

(a) Adjust the power supply output to the normal operating voltage.

(b) Slowly turn the OV adjust control CCW until the output voltage sharply drops and front panel fault light comes on.

(c) Refer to the chart below, select the appropriate volts/turn ratio and turn the OV adjust control clockwise by the number of turns equivalent to 15% of the operating voltage (or 1,5 volts, whichever is greater) to bring the OV set-point to the proper value.

MODEL	NOMINAL VOLTS PER TURN (O.V ADS)
LLS-3008	0.7
LLS-3018	2.1
LLS-3040	4.3
LLS-3060	6.2
LLS-3120	11.0

OPERATION AFTER PROTECTIVE DEVICE SHUTDOWN

Thermal Shutdown. When over temperature occurs, a normally open thermostat will close, thereby forcing the main oscillator to oscillate at its minimum frequency. The series regulator will be cutoff and will zero output voltage and current. Front panel indicator will turn on to indicate a fault condition. The thermostat will reset automatically when over temperature condition will be eliminated.

Fuse Shutdown. Fuse will blow when the maximum rated current value for the fuse is exceeded. Fatigue failure of fuse can occur when mechanical vibrations from the installation combine with thermally induced stresses to weaken the fuse metal. Many fuse failures are caused by a temporary condition and replacing the blown fuse will make the fuse protected circuit operative.

NOTE: Power should be removed from the unit before checking or replacing the fuse.

Overvoltage Shutdown. When the power supply output increases above the overvoltage limit, the overvoltage protection circuit will cause the output voltage to go to zero. During overvoltage shutdown, the front panel fault indicator lamp will be lit. After eliminating the cause(s) for overvoltage, resume operation of the power supply by turning off the power supply for a period of at least 10 seconds. (refer to TROUBLESHOOTING CHART).

MAINTENANCE

GENERAL

This section describes trouble analysis routines, replacement procedures and calibration and test procedures that are useful for servicing this Lambda power supply. A trouble chart is provided as an aid for the troubleshooter. Refer to the section on SPECIFICATIONS AND FEATURES for minimum performance standards.

TROUBLE ANALYSIS

Whenever trouble occurs, systematically check the fuse, primary power lines, external circuit elements, and external wiring for malfunction before troubleshooting the equipment. Failures and malfunctions often can be traced to simple causes such as improper jumper and supply-load connections or fuse failure due to metal fatigue.

Use the electrical schematic diagram and block diagram, figure 14, as an aid to locating trouble causes. The schematic diagram contains various circuit voltage that are averages for normal operation. Measure these voltages using the conditions for measurement specified on the schematic diagram. Use measuring probes carefully to avoid causing short circuits and damaging circuit components.

CHECKING TRANSISTORS AND CAPACITORS

Check transistors with an instrument that has a higly limited current capability. Observe proper polarity for PNP or NPN transistors to avoid error in measurement. The forward transistor resistance is low but never zero; backward resistance is always higher than the forward resistance.

For good transistors, the forward resistance for any junction is always greater than zero.

Do not assume trouble is eliminated when only one part is replaced. This is especially true when one transistor fails, causing other transistors to fail. Replacing only one transistor and turning power on, before checking for additional defective components could damage the replaced component.

When soldering semi-conductor devices, wherever possible, hold the lead being soldered with a pair of pliers placed between the component and the solder joint to provide an effective heat sink.

NOTE: The leakage resistance obtained from a simple resistance check of a capacitor is not always an indication of a faulty capacitor. In all cases the capacitors are shunted with resistances, some of which have low values. Only a dead short is a true indication of a shorted capacitor.

PRINTED CIRCUIT BOARD MAINTENANCE TECHNIQUES

1. If foil is intact but not coverd with solder, it is a good contact. Do not attempt to cover with solder

2. In some cases, voltage measurements can be made from either side of the board. Use a needle-point probe to penetrate to the wiring whenever a protective coating is used on the wiring. A brass probe can be soldered to an alligator clip adapted to the measuring instrument.

3. Whenever possible, use a heat sink when soldering transistors.

4. Broken or damaged printed wiring is usually the result of an imperfection, strain, or careless soldering. To repair small breaks, tin a short piece of hook-up wire to bridge the break, and holding the wire in place, flow solder along the length of wire so that it becomes part of the circuitry.

5. When unsoldering components from the board, never pry or force loose the part; unsolder the component by using the wicking process described below:
   (a) Select a 3/16 inch tinned copper braid for use as a wick; if braid is not available, select AWG No. 14 or No. 16 stranded wire with 1/2 inch insulation removed.

   (b) Dip the wick in liquid rosin flux.

   (c) Place the wick onto the soldered connection and apply soldering iron onto the wick.

(d) When sufficient amount of solder flows onto the wick, freeing the component, simultaneously remove iron and wick.

NOTE: When dealing with surface-mount-technology parts, devices with two leads can be removed with a pair of tweezers and a soldering iron first by heating both ends of the device until the solder is melted and then by quickly removing the part with the tweezers. Replacement first requires pre-wetting the mounting pads with a small amount of solder and then holding the new part in place with the tweezers. First one end of the part is heated and then the other end is heated to the point where the solder melts and flows onto the part, thereby forming new solder joints. Care should be exercised to avoid damaging the part(s) because of accidental overheating or mechanical stress.

Remove or repair of SMT devices, which have more than two leads is best left to SMT repair stations specifically designed to handle removal and installation of these parts using special tools and techniques.

TROUBLE CHART

The trouble chart is intended as a guide for locating trouble causes and is used along with the schematic diagram.

The operating conditions assumed for the trouble chart are as follows:

(a) AC power of proper voltage and frequency is present at input terminals.

(b) Power supply is connected for constant voltage with local sensing.

(c) Front panel programmed for full scale voltage and current unless otherwise noted.

SAFETY NOTICE

DANGEROUS VOLTAGES, DUE TO CHARGED CAPACITORS, MAY EXIST IN THIS EQUIPMENT EVEN IF AC POWER IS REMOVED. OBSERVE NORMAL SAFETY PRECAUTIONS WHEN SERVICING.

TROUBLESHOOTING CHART

Symptom	Probable cause	Remedy
1. Zero volts DC output (with front panel programmed for maximum voltage and current.)	Short circuit across output of supply.	Check load connections. Correct as necessary.
Additional Symptoms		
A. OV/OT fault indicator light on.	Overvoltage fault	See manual section on procedure for setting OV adjust.
	Overtemperature fault	Check for air inlet blockage.
B. Front panel operational.	Panel not programmed properely	See manual section on procedure for proggramming front panel.
C. Front panel operational. 5 volts measured from RVP to common and from RCP to common. Zero or negetive voltage from TB101-7 to common.(TB101-6)	IC102 or Q101 defective.	Check and replace as necessary.
	CR104 opern	
D. Front panel operational. 5V measured from RVP and RCP to common. Greater than 4V from TB101-7 to common.(TB101-6)	Q104, IC103 defective.	Check and replace as necessary.
	CR105 open CR106, CR118, CR119 shorted.	Check and replace as necessary.
E. Front panel operational. RVP or RCP to common do not measure 5V.	Front panel circuitry defective.	See section of TROUBLESHOOTING CHART referring to front panel.
	IC102 defective	Check and replace as necessary.
F. Front panel operational. 5V measured from RVP and RCP to common. Negetive voltage from IC103 pin 8 to common.(TB101-6)	Open circuit at remote on/off terminal TB101-5	Checkout wiring. Correct as necessary.
G. Front panel not operational.	Ribbon cable from J103 to front panel is disconnected.	Check and repair as necessary.
H. Front panel not operational. Ribbon to J103 ok.	Front panel circuitry defective. IC104, IC105 or IC106 defective.	See section of TROUBLESHOOTING CHART referring to front panel. Check and replace as necessary.

TROUBLESHOOTING CHART (Cont'd)

Symptom	Probable Cause	Remedy
Zero output continued:		
I. RVP to common or RCP to common do not measure 5V. Output of bias regulators IC104 and IC105 not +/12V (respectively). Inputs ok.	IC104, IC105 defective.	Check and replace as necessary.
J. Same as above, except inputs of IC104/105 not correct.	Pre-regulator circuit not operational.	Refer to TROUBLESHOOTING CHART refferring to pre-regulator.
2. High output voltage, no control of output.	Open sense lead.	Refer to appropriate connection diagram and correct as required.
3. Unit cannot be adjusted to attain rated Vo or Io or minimum output.	Unit out of calibration.	Refer to CALIBRATION PROCEDURES in manual and re-calibrate unit in the proper sequence.

TROUBLESHOOTING CHART - PRE REGULATOR

Symptom	Probable Cause	Remedy
1. Zero volts DC output		
a. Front panel display dark. F1 not blown. No waveform at Q202.	IC201, Q202 or IC203 defective. CR220 (8 : 40V units) CR221, CR222, CR223 (60 and 120V units) shorted.	Check and replace as necessary
b. F1 blown.	CR201, C208, C209 Q202 shorted.	Check and replace as necessary.
c. Front panel operational. Unit cannot be adjusted to attain Vo or Io.	IC101 or IC202 defective CR116 shorted	Check and replace as necessary
2. High output voltage. No control of output.	IC101 or IC202 defective Q104 shorted.	Check and replace as necessary.

TROUBLESHOOTING CHART - FRONT PANEL

Sympton	Probable cause	Remedey
1. Front panel display dark. Power supply operational (+12V at IC104 output, - 12V at IC105 output, + 12V at IC106 output)	Ribbon cable from J103 to front panel disconnected. Ribbon cable from J602 to J501 disconnected	Check and repair as necessary Check and repair as necessary.
Additional Symptoms	**Probable Cause**	**Remedy**
A. 5 volts not measured from pin 3 of IC601 (micro-controller) to TP2.	IC106(+5V regulator) defective.	Check and repair as necessary.
B. 5 volts measured from pin 3 of IC601 to TP2.	IC601 defective.	Check and replace as necessary.
2. Panel will not program to rated output.	Power supply out of calibration Front panel not initialized properly IC605 (D to A converter), IC608(buffer amplifier) defective.	Refer to CALIBRATION procedure and recalibrate unit in proper sequence. Refer to chart below for proper S601 settings. Check and replace as necessary.

TROUBLE SHOOTING CHART - FRONT PANEL - (Cont'd)

Symptoms	Probable Cause	Remedy
3. Panel will not measure voltage or current properly.	Power supply out of calibration	Refer to CALIBRATION procedure and recalibrate unit in proper sequence. Refer to chart below for proper S601 settings.
	Front panel not initialized properly	
	IC605(D to A converter), IC607(switched capacitor interface). IC609 (current signal amplifier), IC610 (measurement comparator) defective.	Check and replace as necessary

FRONT PANEL INITIALIZATION - S601 SWITCH SETTINGS

MODEL	S601 BIT									
	1	2	3	4	5	6	7	8	9	10
LLS 3008	OFF	OFF	OFF	ON	ON	OFF	OFF	OFF	*	*
LLS 3018	ON	OFF	OFF	ON	OFF	ON	ON	ON	*	*
LLS 3040	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF	*	*
LLS 3060	ON	ON	OFF	ON	OFF	OFF	ON	ON	*	*
LLS 3120	OFF	OFF	ON	OFF	ON	ON	ON	OFF	*	*

* Bits 9 and 10 should be on for all models except during calibration of the front panel, when they both should be off.

PERFORMANCE CHECKS

Checks With Constant Voltage Operation. Check the ripple and regulation of the power supply using the test connection diagram shown in figure 12. Use suggested test equipment or equivalent to obtain accurate results. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Load regulation can be checked by varying the load from no-load to full-load while monitoring the output voltage. Line regulation can be measured by varying the input with a variac between low line and high line while observing the output voltage. Good technical judgement should be observed in the routing and layout of test leads to minimize AC pickup.

Output ripple should be measured directly at the power output terminals of the power supply.
A 20 MHz bandwidth oscilloscope should be used. In order to minimize pick up from close proximity radiated fields, the length of the ground wire on the scope probe should be minimal. A true RMS voltmeter similar to a FLUKE 8920 A should be used to measure RMS output ripple.

Checks With Constant Current Operation. Check the regulation of the power supply using the test connection diagram shown in figure 13. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Load regulation can be checked by switching from a short circuit to a maximum output voltage condition while monitoring the output current via the current-measuring shunt. Line regulation can be measured by varying the input line with a variac while monitoring the output current via a current-measuring shunt. In order to measure the relatively small regulation signal, a shunt of sufficiently large voltage drop should be used.

Constant current RMS ripple should be measured by connecting a true RMS voltmeter across the current measuring shunt. A low-pass filter comprised of a resistor and capacitor may be required to filter out high frequency noise spikes due to shunt inductance and pickup.

POWER SUPPLY CALIBRATION PROCEDURE

The following is a list of calibration controls located within the LLS-3000 power supply:

R116	Vo(max) adjust
R119	Vo(min) adjust
R120	Io (max) adjust
R128	Io(max) adjust
R160	Vo(meas) adjust
R632	Io(min) meas adj
R634	Io(max) meas adj

Calibration of R119 must always be performed together with that of R116. Calibration of R120 must always be performed together with that of R128. Calibration of 632 must always be performed with that of R634.

Before performing any calibrations, the power supply must be removed from associated equipment and must be at an ambient of 25 to 30° C. Unit must be wired in local sense with internal programming, figure 3, and must be operating from a nominal AC line.

Calibration of Output-Voltage-Range Controls R119 and R116.

1. With no load on the output of the power supply, program the front panel voltage programmer for zero.
2. While monitoring the output voltage, with an external DVM, adjust R119 so that Vo is between -.01 and +.01 volts.
3. Program the front panel voltage programmer for the rated output voltage of the supply.
4. Adjust R116 until the output voltage monitored from +V to -V with an external DVM indicates the rated output voltage of the supply +/-.01 volts.
5. Seal R116 and R119 with RTV sealant.

Calibration of Output-Current-Range Controls R120 and R128.

1. With no lead on the output of the power supply, program the front panel current programmer for zero.
2. Apply a short-circuit through a measurement shunt connected across the output of the supply, figure 13.
3. Adjust R120 until the measured output current is between -0.01 and +0.01 amps.
4. Program the front panel current programmer for the rated 40°C output current of the supply.
5. Adjust R128 until the monitored output current is the rated 40° C current of the supply +/-.01 amps.
6. Seal R120 and R128 with RTV sealant.

Calibration of Vo(meas) adjust R160.

1. With AC power removed from the supply, set bits 9 and 10 of S601, located on front panel P.C. board F, to the OFF position.
2. Apply power to the unit. Program for rated output voltage with no load connected at the output.

3. Adjust R160 until the reading presented by the front panel voltmeter corresponds with that of an external DVM connected to the output.

4. Remove power to the supply. Reset bits 9 and 10 of S601 to the ON position. Seal R160

Calibration of Io(min) measure R632 and Io(max) measure R634.

1. With AC power removed from the supply, set bits 9 and 10 of S601, located on front panel P.C. Board F, to the off position.

2. Apply power to the unit. With no load connected at the output, monitor the voltage between test points TP1 and TP2 located at the top of the front panel P.C. Board F. Adjust R632 (potentiometer located closest to the top of the P.C. Board f) so that the voltage between TP1 and TP2, as measured with an external DVM, is be tween +0.01 and -0.01 volts. Seal R632.

3. Apply a short circuit across the output terminals of the supply through a current measurement shunt.

4. Program the supply for rated voltage and rated current.

5. Adjust R634 so that the reading presented by the front panel ammeter agrees with that of the external shunt Seal R634.

6. Remove power to the unit. Reset bits 9 and 10 of S601 to the ON position.

SERVICE

When additional instructions are required or repair service is desired, contact the nearest Lambda office trained personal and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem. On receipt of this information Lambda will supply service data or advice shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and an estimate forwarded for approval before work is started.

PARTS ORDERING

Standard components and special components in the Lambda power supply can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. Model number and serial number of power supply and purchase date.

2. Lambda part number.

3. Description of part together with circuit designation.

4. If part is not an electronic part, or is not listed, provide a description, function and location of the part.

PARTS LIST

The electrical parts located on Lambda models LLS-3000 are listed here. Parts common to a group of models are listed first. Unique parts of individual models within the group are listed separately, by model, immediately following the group are common-parts listing

COMMON PARTS MODELS LLS-3008-LLS-3120

CIRC. DESIG.	DESCRIPTION	LAMBDA No.
C2 thru C100	Not assigned	
C101	Cap. Tant. 0.1 mf, 20%, 35v	SCBN-10-0002
C102	Cap. Cer. 0.1mf, 20%, 500v	CDM-10-002
C103	Same as C101	
C104	Cap. Car. SMD, 0.1 mf, 20%, 50v	SCDM-10-0007
C105	Same as C104	
C106	Cap. Cer. SMD, 0.01 MF, 20%, 50V	SCDL-10-0006
C107	Same as C104	
C108	Same as C104	
C112	Not assigned	
C113	Same as C104	
C114	Same as C104	
C115	Cap. Tant. SMD, 0.68 mf, 20v	SCBM-68-0001
C116	Same as C106	
C117	Same as C104	
C118	Same as C104	
C121	Same as C106	
C124	Cap. Cer. SMD, 0.22mf., 20%, 50v	SCDM-22-0008
C127	Cap. Cer. SMD., 4700 pf, 20%, 50v	SCDK-47-0166
C128	Same as C102	
C133	Same as C102	
C135	Not assigned	
C136	Same as C102	
C137	Sameas C102	
C138 thru C200	Not assigned	
C201	Cap. Cer., 4700 pf, 250v	CDK-47-027
C202	Same as C201	
C203	Cap. X type, 0.22mf, 250v	CBM-22-013
C204	Same as C201	
C205	Same as C201	

COMMON PARTS MODELS LLS-3008-LLS-3120

CIRC. DESIG.	DESCRIPTION	LAMBDA No.
C206	Same as C203	
C207	Cap. paper y-type, 0.01 mf, 250v	CAL-10-024
C208	Cap. Elect., 150 mf, 20%, 200v	CBR-15-311
C209	Same as C208	
C210	Cap. Elect., 40v 180 mf, -10%+100%,	CBR-18-155
C211	Cap. Cer., 0.1 mf, 20%, 50v	CDM-10-012
C212	Cap. Elec., 3.3 mf, 20%, 16v	CBN-33-079
C213	Cap. Mylar, 4700 pf, 10%, 200v	CKK-47-014
C214	Same as C211	
C215	Cap. Elec., 22 mf, 20%, 25v	CBP-22-185
C216	Cap. Mica, 330 pf, 5%, 63v	CCJ-33-001
C217	Cap. MYLAR., 560 pf, 10%, 200v	CGJ-56-001
C218	Cap. Pol. Prop., 220 pf, 16 00v	CKJ-22-003
C219	Cap. Cer., 0.33 mf, 20%, 50v	CDM-33-013
C223	Cap. Cer., 0.1 mf, 20%, 500v	CDM-10-002
C224	Not assigned	
C225	Cap. Elec., 470mf 20%, 63v	CBR-47-289
C226	Same as C225	
C227	Same as C225	
C228	Same as C223	
C229	Same as C223	
C232	Same as C211	
C233	Cap. Cer., 10 pf, 5%, 1000v	CDH-10-002
CR1 thru CR100	Not assigned	
CR101	Zener 6.2v, 0.02V 20ppm, 0.4w	FBMZ-240
CR102	Diode SMD, 100m, 75v	SFBL-00-0040
CR103	Zener SMD, 11v, 5%, 0.25w	SFBM-00-0055

COMMON PARTS
MODELS LLS-3008-LLS-3120

CIRC. DESIG.	DESCRIPTION	LAMBDA No.
CR104 thru CR 107	Same as CR102	
CR108	Not Assigned	
CR109	Zener diode SMD, 6.2V, 5%, 0.225w	SFBM-00-0042
CR110 thru CR114	Same as CR102	
CR116	Same as CR102	
CR118	Diode 100v 1N4002	FBL-00-030
CR119	Same as CR118	
CR120	Same as CR102	
CR121	Same as CR102	
CR122	Zener SMD 3.3v, 5%, 0.5w	SFBM-00-0041
CR123 thru CR200	Not assigned	
CR201	Bridge 3A, 400v	FBL-00-293
CR202	Diode 2A, 200v	FBL-00-247
CR203	Zener 20v, 5% 5w	FBMZ-235
CR204	Zener 18v, 5% 1w	FBMZ-154
CR205	diode Ultra FAST 600v, 1A	FBL-00-223
CR206	Zener 200v, 5% 5w	FBMZ-229
CR207	Same as CR206	
CR208	Same as CR202	
CR209	Diode, 2A, 200v	FBL-00-247
CR210	Diode, 0.4.A, 70v	FBL-00-082
CR211	Not assigned	
CR212	Same as CR 202	
CR213 thru CR215	Same as CR210	
CR216	Same as CR204	
CR217	Same as CR210	
CR218	Diode U. Fast 1A 1000v	FBL-00-266
F1	Fuse, 2.5A, 250v	FFB-02-500
IC 101 thru IC103	quad. op. amp. SMD	SFBT-00-0051
IC104	Regulator, 12v	FBT-00-218
IC105	Same as IC104	
IC 106	Regulator, 5v	FBT-00-215
IC107 thru IC200	Not assigned	
IC201	Control IC	FBT-00-163
IC202	Opto Coupler	FBNL-298
IC203	IC TO-92-TL431	FBT-00-137
J1	A/C Receptacle	HKA-03-021

COMMON PARTS
MODELS LLS-3008-LLS-3120

CIRC. DESIG.	DESCRIPTION	LAMBDA No.
J2 thru J100	Not assigned	
J101	Terminal block 11 pin	HAJ-11-217
J102	Connectors PCB, 12 pin	HKA-12-011
J103	Connector Flat cable 14 pin	HKA-14-010
J104	Barrier Strip 2 pin	HAJ-02-165
J105	Header Post	HKA-02-017
J106	Same as J105	
J107 thru J201	Not assigned	
J202	Connector PCB, 12 pin	HKA-12-011
J203	Connector male, 3 pin	HKA-03-024
L101	Toroid	BBLS-3101
L102 thru L200	Not assigned	
L201	Toroid	BBLS-3201
L202	Toroid	BBLS-3202
L203	Toroid	BBLS-3203
Q101	Mosfet P-CH 3N157	FBNL-315
Q103	Transistor NPN	FBNL-110
Q105 thru Q200	Not assigned	
Q201	Transistor PNP	FBNL-199
Q202	Mosfet N-CH 6A 850V	FBNL-291
R1 thru R100	Not assigned	
R101	Res. SMD, 825 ohms, 1%, 1/8w	SDER-83-0015
R102	Not assigned	
R103	Res. SMD, 32.400 ohms, 1%, 1/8w	SDET-32-0031
R104	Res. SMD, 2.430 ohms, 1%, 1/8w	SDES-24-0022
R105 thru R108	Res. METAL FILM, 47.500 ohms, 1% 1/20w 5ppm	DCT-48-181
R117	Res. SMD, 15.000 ohms, 1%, 1/8w	SDET-15-0030
R118	Same as R117	
R119	Res. Var., 10.000 ohms, 10%, 1/2w	DRT-10-065
R120	Same as R119	
R121	Not assigned	
R122	Res. SMD., 100,000 ohms, 1%, 1/8w	SDEV-10-0033

COMMON PARTS
MODELS LLS-3008-LLS-3120

CIRC. DESIG.	DESCRIPTION	LAMBDA No.
R123	Res. SMD, 6.340 ohms, 1%, 1/8w	SDES-63-0025
R124	Not assigned	
R125	Same as R103	
R126	Res. SMD, 60.4 ohms, 1%, 1/8w	SDEP-60-0164
R127	Res. SMD, 2150 ohms, 1%, 1/8w	SDES-22-0020
R128	Res. Var., 200 ohms, 10%, 1/4w, 12T	DRR-20-019
R129	Res. SMD, 1650 ohms 1%, 1/8w	SDES-17-0019
R130	Res. SMD 40.2 ohms, 1%, 1/8w	SDEP-40-0162
R131	Same as R123	
R132	Res. SMD, 20.000 ohms, 1%, 1/8w	SDET-20-0070
R133	Res. SMD, 10.000 ohms, 1%, 1/8w	SDET-10-0028
R134	Same as R133	
R135	Res. SMD, 4530 ohms, 1%, 1/8w	SDES-45-0073
R136	Same as R133	
R137	Same as R104	
R144	Res. SMD. 2.150 ohms, 1%, 1/8W	SDES-22-0020
R145	Res. SMD, 30.1 ohms, 1%, 1/8w	SDEP-30-0011
R151	Res. SMD, 1.650 ohms, 1%, 1/8w	SDES-17-0019
R153	Res. SMD, 1000 ohms, 1%, 1/8w	SDES-10-0018
R154	Res. SMD, 2.430 ohms, 1%, 1/8w	SDES-24-0022
R155	Same as R103	
R156	Not assigned	
R159	Res. SMD, 1500 ohms, 1%, 1/8w	SDET-15-0030
R162	Res. Oxide, 150 ohms, 5%, 3w	DSR-15-001
R163	Res. Oxide, 430 ohms, 5%, 3w	DSR-43-007
R164	Res. Car. FILM 1200 ohms, 5%, 1/2w	DDE-1225
R165	Res. SMD, 8.250 ohms, 1%, 1/8w	SDES-83-0026

COMMON PARTS
MODELS LLS-3008-LLS-3120

CIRC. DESIG.	DESCRIPTION	LAMBDA No.
R166	Same as R129	
R167	Not Assigned	
R168	Same as R127	
R169 thru R200	Not Assigned	
R201	Res. Comp, 680.000 ohms 10%, 1/2w	DEB-6841
R202	Thermistor, 5 ohms, 15%	DKN-50-001
R203	Res, Oxide, 24.000 ohms, 5%, 3w	DST-24-002
R204	Same as R203	
R205	Res. Oxide 33 ohms 5%, 3w	DSP-33-005
R209	Res. Car., 330.000 ohms, 5%, 1/4w	DDB-3345
R210	Res. Film,11.800 ohms, 1%, 1/4w	DCT-12-066
R211	Res. Film, 1 Mega ohms, 1%, 1/2w	DCW-10-003
R212	Res. Car., 5.600 ohms, 5%, 1/4w	DDB-5625
R213	Res, Film, 22.600 ohms, 1%, 1/4w	DCT-23-128
R214	Res. Film, 91.000 ohms, 2%, 1/4w	DCT-91-061
R215	Res. Film, 140.000 ohms, 1%, 1/2w	DCV-14-040
R216	Res. Cer, 24 ohms, 5%, 1/4w	DDB-1505
R217	Rec. Cer., 27.000 ohms, 5%, 1/4w	DDB-2735
R218	Rec. Cer., 390 ohms, 5%, 1/4w	DDB-3915
R219	Rec. Oxide, 1 ohm, 5%, 2w	DSN-10-007
R220	Rec. WW., 1800 ohms, 5%, 5w	DFS-18-026
R221	Same as R220	
R226	Res. Comp., 47.000ohms 5%, 1/4w	DCB-4745
S1	Thermostat N.O. 94C	FKA-94-025
S2 thru S200	Not assigned	
S201	Switch DPDT	FDE-22-006
V201	Varistor 250v	DVR-27-002

UNIQUE PARTS
MODEL LLS-3008

CIRC. DESIG.	DESCRIPTION	LAMBDA No.
C1	Cap. Cer., 0.1 mf, 20%, 100v	CDM-10-011
C109	Cap. Tant., 1mf, 20%, 35v	CBN-10-009
C110	Cap. Cer., 0.1 mf, 10%, 100v	CDM-10-011
C111	Cap. Cer. SMD, 4700 mf, 20%, 50v	SCDK-47-0166
C119	Cap. Cer. SMD, 0.1 mf, 20%, 50v	SCDM-10-0007
C120	Cap. Cer. SMD, 0.047 mf, 20%, 50v	SCDM-47-0078
C122	Cap. Cer. SMD, 0.022 mf, 20%, 50v	SCDM-22-0160
C123	Cap. Cer. SMD 4700 PF, 20%, 50V	SCDK-47-0166
C125	Same as C110	
C126	Same as C122	
C129	Same as C110	
C130	Cap. Elec., 330 mf, 20%, 63v	CBR-33-314
C131	Same as C130	
C132	Same as C110	
C134	Same as C110	
C220	Cap. Cer., 1500 pf, 100v	CDK-15-041
C221	Cap. Cer., ±10% 0.1 mf, 100v	CDM-10-011
C222	Cap. Elec. 2700 mf, 20%, 20v	CBS-27-339
C230	Not Assigned	
C231	Not Assigned	
CR115	Zener diode, 12v, 5%, 1N	FBMZ-155
CR117	Not Assigned	
CR219	Diode ULTRA FAST, 1A, 600v	FBL-00-223
CR220	Diode 45v, 20A	FBL-00-258
CR221 thru CR223	Not Assigned	
L204	CHOKE	BBA-LS-3008
Q102	Transistor NPN, 60v, 4A	FBNL-279
Q104	Transistor Mosfet, 12A, 50v	FBN-L-238
R109	Res. SMD, 499 ohms, 1%, 1/8w, 25 PPM	SDER-50-0207
R110	Res. SMD, 2.430 ohms, 1%, 1/8w	SDES-24-0022
R111	Res. SMD, 22.100 ohms, 1%, 1/8w	SDET-22-0066
R112	Same as R110	
R113	Res. SMD, 402 ohms, 1%, 1/8w	SDEP-40-0162

UNIQUE PARTS
MODEL LLS-3008

CIRC. DESIG.	DESCRIPTION	LAMBDA No.
R114	Res. METAL Film, 1540 ohms,1%, 1/2w, 25ppm	DCS-15-202
R115	Not Assigned	
R116	Res. Var., 200 ohms, 10%, 1/4w, 12T	DRR-20-019
R121	Res. SMD, 1%, 1/8w, 619.000 ohms	SDEV-62-37
R138	Same as R121	
R139	Res. SMD, 6340 ohms, 1%, 1/8w	SDES-63-0025
R140	Res. SMD, 604 ohms, 1%, 1/8w	SDER-60-0014
R141	Res. SMD, 4.990 ohms, 1%, 1/8w	SDES-50-0024
R142	Same as R141	
R143	Res. SMD, 200.000 ohms, 1%, 1/8w	SDEV-20-0163
R146	Res. Cer., 2.2 ohms, 5%, 1/4w	DDB-22G5
R147	Res. Cer., 100 ohms, 5%, 1/4w	DDB-1015
R148	Res, Cer, 820 ohms, 5%, 1/2w	DDE-8215
R149	Res. Oxide, 82 ohms, 5%, 3w	DSP-81-007
R150	Same as R149	
R152	Res. 4w, 0.05 ohms, 1%, 3w	DEL-50-004
R157	Res, SMD, 16.900 ohms, 1%, 1/8w	SDES-17-0120
R158	Res, SMD, 30.900 ohms, 1%, 1/8w	SDET-31-0121
R160	Res. Var, 10.000 ohms, 10%, 1/4w, 12T	DRT-10-066
R161	Same as R139	
R206	Res. Car., 150 ohms, 5%, 1/4w	DDB-1515
R207	Res. METAL FILM, 1470 ohms, 1%, 1/4w	DCS-15-056
R208	Res. Car, 15.000 ohms, 5%, 1/4w	DDB-1535
R222	Rec WW, 110 ohms, 5%, 5w	DFR-11-115
R223	Same as R222	
R224	Same as R205	
R225	Res. Film,121.000 ohms, 1%, 1/2w	DCV-12-019
T201	Transformer	ABA-LLS-3008

UNIQUE PARTS
MODEL LLS-3018

CIRC. DESIG.	DESCRIPTION	LAMBDA No.
C1	CAP. CER., 0.1 mf, 20%, 100v	CDM-10-011
C109	Cap. Elec., 1mf, 20%, 35v	CBN-10-009
C110	Cap. Cer., 0.1 mf, 10%, 100v	CDM-10-011
C111	Cap. Cer. SMD, 4700 pf, 20%, 50v	SCDK-47-0166
C119	Cap. Cer. SMD, 0.1 mf, 20%, 50v	SCDM-10-0007
C120	Same as C119	
C122	Cap. Cer. SMD, 0.022 mf, 20%, 50v	SCDM-22-0160
C123	Cap. Cer.SMD, 6800 pf, 20%, 50v	SCDK-68-0005
C125	Same as C110	
C126	Same as C122	
C129	Same as C110	
C130	Cap. Elec., 330 mf, 20%, 63v	CBR-33-314
C131	Same as C130	
C132	Same as C110	
C134	Same as C110	
C220	Cap. Cer., 1000 pf, ±20%, 1kv	CDK-10-010
C221	Cap. Cer., 0.1 mf, 100v, ±10%	CDM-10-011
C222	Cap. Elec., 1500 mf, 20%, 40v	CBS-15-327
C230	Not Assigned	
C231	Not Assigned	
CR115	Zener diode, 12v, 5%, 1w	FBM-Z-155
CR117	Not Assigned	
CR219	ULTRA FAST 1A, 600v	FBL-00-223
CR220	Diode 200v, 6A, 6A, 200v	FBL-00-282
CR221 thru CR223	Not Assigned	
L204	CHOKE	BBALS-3018
Q102	Transistor NPN, 4A, 60v	FBNL-279
Q104	MOSFET,N CH 12A, 50v	FBNL-238
R109	Res. SMD, 499 ohms 1%, 1/8w, 25 PPM	SDER-50-0207
R110	Res. SMD, 2.430 ohms, 1%, 1/8w	SDES-24-0022
R111	Res. SMD, 32.400 ohms, 1%, 1/8w	SDET-32-0031
R112	Same as R110	
R113	Res. SMD, 40.2 ohms, 1%, 1/8w	SDEP-40-0162
R114	Res METAL FILM, 3.240 ohms, 1%, 1/2w, 25PPM	DCS-32-203
R116	Res. Var, 1000 ohms, 10%, 1/4w, 12T	DRS-10-047
R121	Res. SMD, 619.000 ohms, 1%, 1/8w	SDEV-62-0037

UNIQUE PARTS (Cont.)
MODEL LLS-3018

CIRC. DESIG.	DESCRIPTION	LAMBDA No.
R138	Same as R121	
R139	Res. SMD, 4.530 ohms, 1%, 1/8w	SDES-45-0073
R140	Res. SMD, 604 ohms 1%, 1/8w	SDER-60-0014
R141	Res. SMD, 8.250 ohms, 1%, 1/8w	SDES-83-0026
R142	Same as R141	
R143	Res. SMD, 200.000 ohms, 1%, 1/8w	SDEV-20-0163
R146	Res. Cer, 5.6 ohms, 5%, 1/4w	DDB-56G5
R147	Res. Cer, 68 ohms, 5%, 1/4w	DDB-6805
R148	Res. Cer. 1800 ohms, 5%, 1/2w	DDE-1825
R149	Res Oxide, 360 ohms, 5%, 3w	DSR-36-016
R150	Res. Oxide, 430 ohms, 5%, 3w	DSR-43-007
R152	Res. WW, 0.11 ohms, 1%, 3w	DEM-11-012
R157	Res., SMD 6190ohms 1%, 1/8w	SDES-62-0116
R158	Res. SMD, 11000 ohms, 1%, 1/8w	SDET-11-0118
R160	Res. Var, 10.000 ohms, 10%, 1/4w, 12T	DRT-10-066
R161	Same as R111	
R206	Res. Car, 150 ohms, 5%, 1/4w	DDB-1515
R207	Res. Metal Film 1.400 ohms, 1%, 1/4w	DCS-14-193
R208	Res. Car., 15.000 ohms, 5%, 1/4w	DDB-1535
R222	Res. WW, 350 ohms, 5%, 5W	DFR-35-147
R223	Same as R222	
R224	Res. Oxide, 82 ohms, 5%, 3w	DSP-81-007
R225	Res. Film, 121.000 ohms, 1%, 1/2W	DCV-12-019
T201	Transformer	ABA-LLS-3018

UNIQUE PARTS
MODEL LLS-3040

CIRC. DESIG.	DESCRIPTION	LAMBDA No.
C1	Cap. Cer., 0.1 mf, 20%, 100v	CDM-10-011
C109	Cap. Cer, 1 mf, 20%, 200v	CBN-10-091
C110	Cap. Cer, 0.1 mf, 10%, 100v	CDM-10-011

UNIQUE PARTS
MODEL LLS-3040

CIRC. DESIG.	DESCRIPTION	LAMBDA No.
C111	Cap. Cer. SMD, 0.01 m f, 20%, 50v	SCDL-10-0006
C119	Cap. Cer. SMD, 0.22 mf, 20%, 50v	SCDM-22-0008
C120	Same as C119	
C122	Cap. Cer. SMD, 0.068 PF, 20%, 50V	SCDM-68-0161
C123	CAP. CER. SMD, 6800 MF, 20%, 50V	SCDK-68-0005
C125	SAME AS C110	
C126	Cap. Cer.SMD, 0.022 mf, 20%, 50v	SCDM-22-0160
C129	Same as C110	
C130	Cap. Elec. 330 mf, 20%, 63v	CBR-33-314
C131	Cap. Elec., 180 mf, 20%, 60v	CBR-18-313
C132	Same as C110	
C134	Same as C110	
C220	Cap. Cer., 240 pf, ±20, 1Kv	CDJ-24-001
C221	Cap. Cer., 0.1 mf, ±10%, 100v	CDM-10-011
C222	Cap. Elec., 470 mf, 20%, 75v	CBR-47-316
C230	Not Assigned	
C231	Not Assigned	
CR115	Zener diode, 12v, 5%, 1w	FBM-Z-155
CR117	Not Assigned	
CR219	Diode U. Fast 1A, 600v	FBL-00-223
CR220	Diode 6A, 200v	FBL-00-282
CR221 thru CR223	Not Assigned	
L204	CHOKE	BBA-LS-3040
Q102	Transistor NPN, 4A, 60v	FBN-L-279
Q104	Mosfer, N CH 8A, 100v	FBN-L-277
R109	Res. SMD, 499 ohms, 1%, 1/8w, 25 PPM	SDER-50-0207
R110	Res. SMD, 825 ohms, 1%, 1/8w	SDER-83-0015
R111	Res. SMD, 15.000 ohms, 1%, 1/8w	SDET-15-0030
R112	Same as R110	
R113	Res, SMD, 40.2 ohms, 1%, 1/8w	SDEP-40-0162
R114	Res. METAL Film, 7.500, ohms, 1%, 1/2w, 25 PPM	DCS-75-204
R116	Res. Var, 1000 ohms, 10%, 1/4w, 12T	DRS-10-047
R121	Res. SMD, 619.000 ohms, 1%, 1/8w	SDEV-62-0037
R138	Res. SMD, 1.8M ohms, 1%, 1/8w	SDEW-18-0039
R139	Res. SMD., 4.530 ohms, 1%, 1/8w	SDES-45-0073
R140	Res. SMD, 2.430 ohms, 1%, 1/8w	SDES-24-0022

UNIQUE PARTS
MODEL LLS-3040

CIRC. DESIG.	DESCRIPTION	LAMBDA No.
R141	Res. SMD,20000 ohms, 1%, 1/8w	SDET-20-0070
R142	Same as R141	
R143	Res. SMD, 200.000 ohms, 1%, 1/8w	SDEV-20-0163
R146	Res. Cer., 12 ohms, 5%, 1.4w	DDB-1205
R147	Res. Cer., 100 ohms, 5%, 1/4w	DDB-1015
R148	Res. Cer., 7.500 ohms, 5%, 1/2w	DDE-7525
R149	Res. Oxide, 2.400 ohms, 5%, 3w	DSS-24-008
R150	Res, Oxide, 1.500 ohms, 5%, 3w	DSS-15-003
R152	Res. WW, 0.25 ohms, 1%, 3w	DEM-25-004
R157	Res. SMD,10500 ohms, 1%, 1/8w	SDET-11-017
R158	Res. SMD, 5360 ohms,	SDES-54-0115
R160	Res. Var, 50.000 ohms, 10%, 1/4w. 12T	DRT-50-068
R161	Res. SMD, 100.00 ohms, 1%, 1/8w	SDEV-10-0033
R206	Res. Car., 180 ohms, 5%, 1/4w	DDB-1815
R207	Res. METAL Film,	DCS-14-193
R208	Res. Cer, 15.000 ohms, 5%, 1/4w	DDB-1535
R222	Res. WW, 1800 ohms, 5%, 5w	DFS-18-026
R223	Same as R222	
R224	Res. Oxide, 750 ohms, 5%, 3w	DSR-75-009
R225	Res. Film, 140.000 ohms, 1%, 1/2w	DCV-14-040
T201	Transformer	ABA-LLS-3040

UNIQUE PARTS
MODEL LLS-3060

CIRC. DESIG.	DESCRIPTION	LAMBDA No.
C1	Cap. Cer., 0.1 mf, 20%, 100v	CDM-10-011
C109	Cap. Mylar, 0.33 mf, 100v	CGM-33-012
C110	Cap. Cer., 0.1 mf, 20%, 100v	CDM-10-011
C111	Cap. Cer. SMD, 4.700 pf, 20%, 50v	SCDK-47-0166

UNIQUE PARTS
MODEL LLS-3060

CIRC. DESIG.	DESCRIPTION	LAMBDA No.
C119	Cap. Cer. SMD, 0.22 mf, 20%, 50v	SCDM-22-0008
C120	Same as C119	
C122	Cap. Cer. SMD 0.068 mf, 20%, 50v	SCDM-68-0161
C123	Cap. Cer. SMD, 0.01 mf, 20%, 50v	SCDL-10-0006
C125	Same as C110	
C126	Same as C123	
C129	Same as C110	
C130	Cap. Elec., 68 mf, 20%, 100v	CBP-68-187
C131	SAme as C130	
C132	Same as C110	
C134	Same as C110	
C220	Cap. Cer., 240 pf, +20%, 1kv	CDJ-24-001
C221	Cap. Cer., 0.1 mf, 20%, 500v	CDM-10-002
C222	Cap. Elec., 330 mf, 20%, 100v	CBB-33-315
C230	Cap. Cer., 10 pf, 5%, 1000v	CDH-10-002
C231	Same as C230	
CR115	Zener diode, 18v, 5%, 1/2w	FBM-Z-154
CR117	Zener, 27v, 5%, 1w	FBM-Z-167
CR219	Ultra Fast Diode, 1A, 600v	FBL-00-223
CR220	Not Assigned	
CR221	Diode, 2A, 200v	FBL-00-247
CR222	Same as CR221	
CR223	Ultra Fast Diode, 4A, 600v	FBL-00-269
L204	CHOKE	BBA-LS-3060
Q102	Darlington, 100v, 2A,	FBNL-270
Q104	Mosfet, N CH 8A, 100v	FBN-L-277
R109	Res. SMD, 499 ohms, 1%, 1/8w, 25 ppm	SDER-50-0207
R110	Res, SMD, 825 ohms, 1%, 1/8w	SDER-83-0015
R111	Res. SMD, 32.400 ohms, 1%, 1/8w	SDET-32-0031
R112	Same as R110	
R113	Res, SMDm 100 ohms, 1%, 1/8W	SDER-10-0012
R114	RES. METAL FILM, 22.100 OHMS, 1%, 1/2W,	DCT-22-186
R115	SAME AS R114	

UNIQUE PARTS
MODEL LLS-3060

CIRC. DESIG.	DESCRIPTION	LAMBDA No.
R116	RES. VAR., 2.000 OHMS, 10%, 1/4W, 12T	DRS-20-048
R121	RES. SMD, 619.000, ohms,1%, 1/8W	SDEV-62-0037
R138	RES. SMD, 1.8 MEGA ohms, 1%, 1/8w	SDEW-18-0039
R139	Res. SMD, 2.430 ohms, 1%, 1/8w	SDES-45-0073
R140	Res. SMD, 6340 ohms, 1%, 1/8w	SDES-63-0025
R141	Res. SMD, 20.000 ohms, 1%, 1/8w	SDET-20-0070
R142	Same as R141	
R143	Res. SMD, 110.000 ohms, 1%, 1/8w	SDEV-11-0034
R146	Res. Car, 15 ohms, 5%, 1/4w	DDB-1505
R147	Res. Car., 1.200 ohms, 5%, 1/4w	DDB-1225
R148	Res. Comp., 150.000 ohms, 5%, 1/2w	DEB-1545
R149	Res, Oxide, 5.600 ohms, 5%, 3w	DSS-56-011
R150	Res. Oxide, 3600 ohms, 5%, 3w	DSS-36-010
R152	Res. WW, 0.35 ohms, 1%, 3w	DEM-35-011
R157	Res. SMD, 7.500 ohms, 1%, 1/8w	SDES-75-0096
R158	Res. SMD, 3650 ohms, 1%, 1/8w	SDES-37-0114
R160	Res. Var, 100.000 ohms, 10%, 1/4w, 12T	DRV-10-021
R161	Same as R143	
R206	Res. Car., 150 ohms, 5%, 1/4w	DDB-1515
R207	Res., 1580 ohms 1%, 1/4w	DCS-16-141
R208	Res. Film, 16.900 ohms, 1%, 1/4w	DCT-17-114
R222	Res. WW, 5.500 ohms, 5%, 5W	DFS-55-096
R223	Same as R222	
R224	Res. Oxide, 1.800 ohms, 5%, 3w	DSS-18-004
R225	Res. Film, 140.000 ohms, 1%, 1/2W	DCV-14-040
T201	TRANSFORMER	ABA-LLS-3060

UNIQUE PARTS
MODEL LLS-3120

CIRC. DESIG.	DESCRIPTION	LAMBDA No.
C1	Cap, Cer, 0.068 mf, 20%, 200v	CDL-68-029
C109	Cap, Cer, 1 mf, 20%, 200v	CBN-10-091
C110	Same as C1	

UNIQUE PARTS
MODEL LLS-3120

CIRC. DESIG.	DESCRIPTION	LAMBDA No.
C111	Cap. Cer. SMD, 0.01 mf, 20%, 50v	SCDL-10-0006
C120	Cap. Cer. SMD, 0.1 mf, 20%, 50v	SCDM-10-0007
C122	Cap. Cer. SMD, 0.22 mf, 20%, 50v	SCDM-22-0008
C123	Cap. Cer. SMD, 3300 pf, 20%, 50v	SCDK-33-0165
C125	Same as C110	
C126	Cap. Cer. SMD, 0.047 mf, 20%, 50v	SCDM-47-0078
C129	Same as C110	
C130	Cap. Elec., 27 mf, 20%, 200v	CBP-27-186
C131	Same as C130	
C132	Same as C110	
C134	Same as C110	
C220	Cap. Cer., 18 pf, ±5%, 1kv	CDH-18-001
C221	Cap. Cer., 0.1 mf, 20%, 500v	CDM -10-002
C222	Cap. Elec., 150 mf, 20%, 200v	CBR-15-312
C230	Cap. Cer., 10 pf, 5%, 1000v	CDH-10-002
C231	Same as C230	
CR115	Zener 27v, 5%, 1w	FBM-Z-167
CR117	Same as CR115	
CR219	Ultra Fast Diode, 1A, 1000v	FBL-00-266
CR220	Not Assigned	
CR221	Ultra Fast Diode 1A, 600v	FBL-00-223
CR222	Same as CR221	
CR223	Ultra Fast Diode, 4A, 1000v	FBL-00-257
L204	CHOKE	BBA-LS-3120
Q102	Transistor NPN, 400v, 1A	FBN-L-293
Q104	Mosfet, N CH 2A, 200v	FBN-L-316
R109	Res. SMD, 1000 ohms, 1%, 1/8w, 25 PPM	SDES-10-0208
R110	Res. SMD, 4.990 ohms, 1%, 1/8w	SDES-50-0024
R111	Res. SMD, 32.400 ohms, 1%, 1/8w	SDET-32-0031
R112	Same as R110	
R113	Res. SMD, 100 ohms, 1%, 1/8w	SDER-10-0012
R114	Res Metal Film, 90,400, 1%, 1/2w, 25 ppm	DCT-91-043
R115	Same as R114	
R116	Res. Var., 5000 ohms, 10%, 1/4w, 12T	DRS-50-049

UNIQUE PARTS
MODEL LLS-3120

CIRC. DESIG.	DESCRIPTION	LAMBDA No.
R121	Res. SMD, 1.8 Mega ohms, 1%, 1/8w	SDEW-18-0039
R138	Same as R121	
R139	Res. SMD, 4990 ohms, 1%, 1/8w	SDES-50-0024
R140	Res. SMD, 15000 ohms, 1%, 1/8w	SDET-15-0030
R141	Res. SMD, 20.000 ohms, 1%, 1/8w	SDET-20-0070
R142	Same as R141	
R143	Res. SMD, 110.000 ohms, 1%, 1/8w	SDEV-11-0034
R146	Res. Car., 24 ohms, 5%, 1/4w	DDB-2405
R147	Res. Car., 1000 ohms, 5%, 1/4w	DDB-1025
R148	Res. Comp., 270.000 ohms, 5%, 1/4w	DDB-2745
R149	Res. Oxide, 12.000 ohms, 5%, 3w	DST-12-009
R150	Same as R149	DST-15-010
R152	Res. WW, 0.7 ohms, 1%, 3w	DEM-70-010
R157	Res. SMD, 11.800 ohms, 1%, 1/8w	SDET-12-0029
R158	Res. SMD, 1820 ohms, 10%, 1/8w	SDES-18-0089
R160	Res. VAR, 100.000 ohms, 1/4w, 12T	DRV-10-021
R161	Res. SMD, 301.000 ohms, 1%, 1/8w	SDEV-30-0036
R206	Res. Car., 150 ohms, 5%, 1/4w	DDB-1515
R207	Res. Metal Film, 1400 ohms, 1%, 1/4w	DCS-14193
R208	Res. Film, 18.200 ohms, 1%, 1/4w	DCT-18-068
R222	Res. WW, 20.000 ohms, 5%, 5v	DFT-200-40
R223	Same as R222	
R224	Res, Oxide, 2400 ohms, 5%, 3w	DSS-24-008
R225	Res. Film, 121.000 ohms, 1%, 1/2w	DCV-12-019
T201	Transformer	ABA-LLS-3120

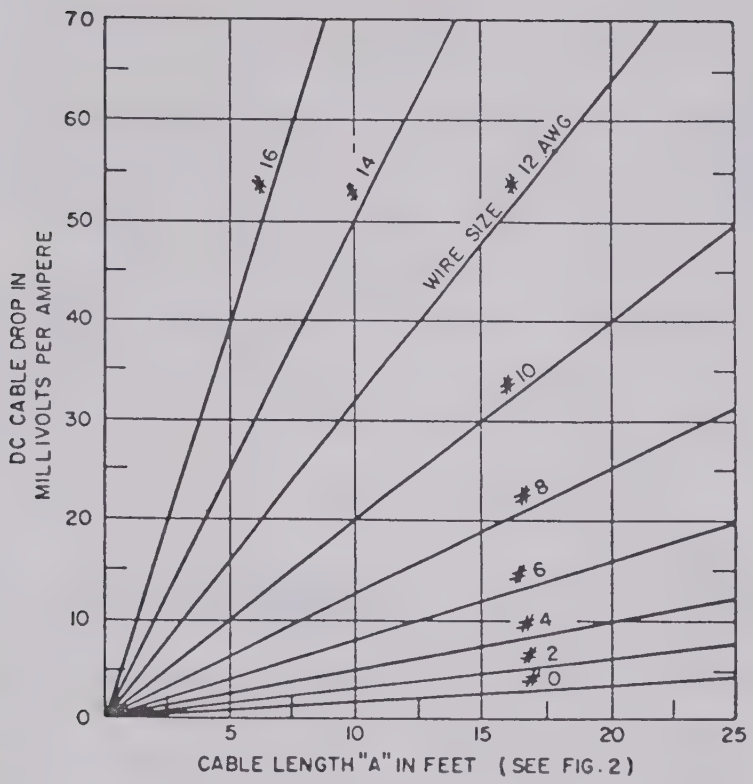


Figure 1. Cable Connection Chart.

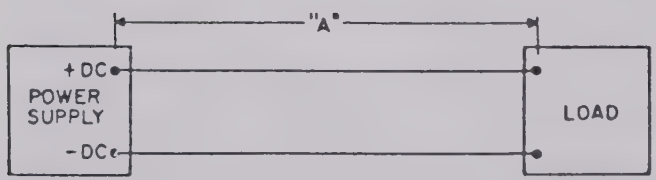
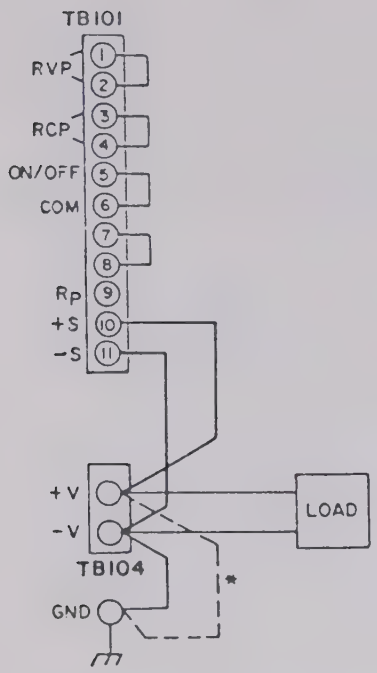
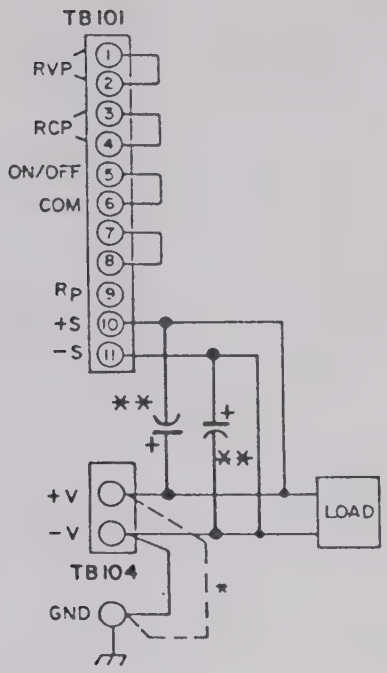


Figure 2. Cable Length "A" in Feet.



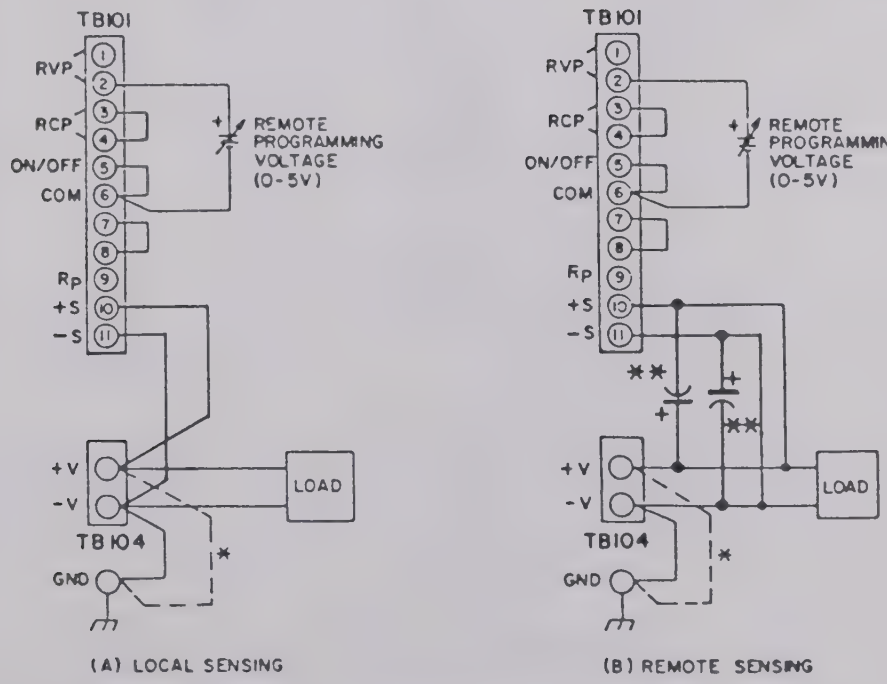
NOTE:
* FOR POSITIVE GROUND, DISCONNECT JUMPER FROM -V TO GND AND RECONNECT FROM +V TO GND.

Figure 3. Local Sensing Connection.



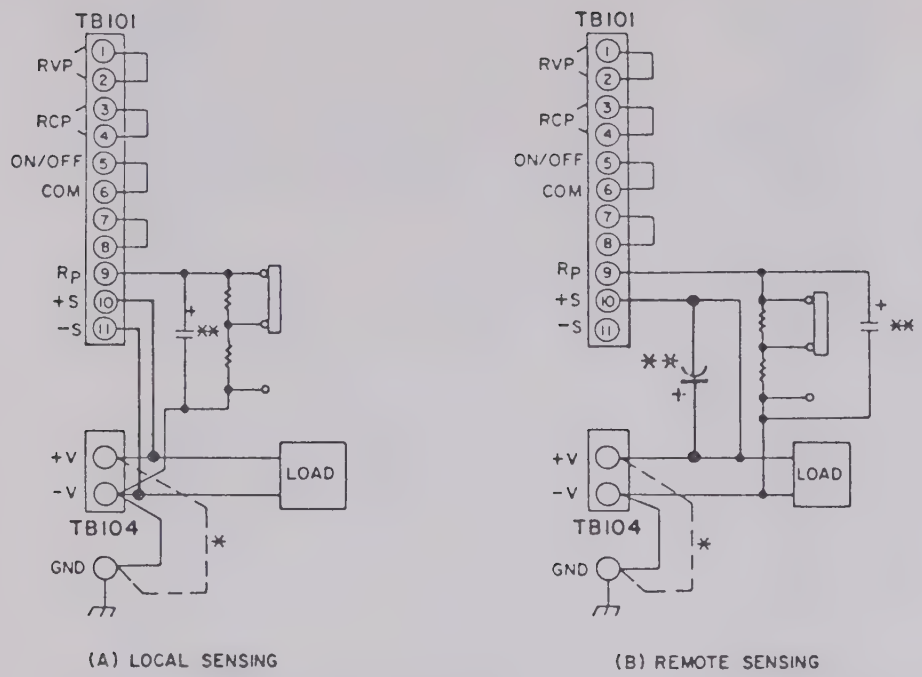
NOTE:
* FOR POSITIVE GROUND, DISCONNECT JUMPER FROM -V TO GND AND RECONNECT FROM +V TO GND.
** A 2.5MF, ELECTROLYTIC CAP. MAYBE REQUIRED.

Figure 4. Remote Sensing Connection.



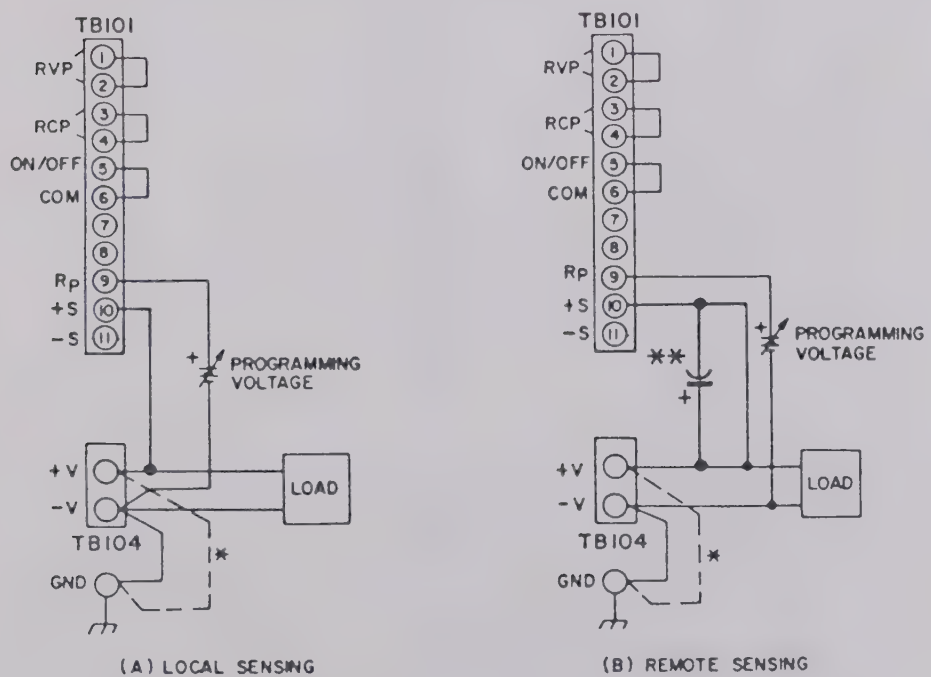
NOTE:
* FOR POSITIVE GROUND, DISCONNECT JUMPER FROM -V TO GND AND RECONNECT FROM +V TO GND.
** A 2.5MF ELECTROLYTIC CAP. MAY BE REQUIRED.

Figure 5. Programmed Constant Voltage Using a Zero to 5V External Source.



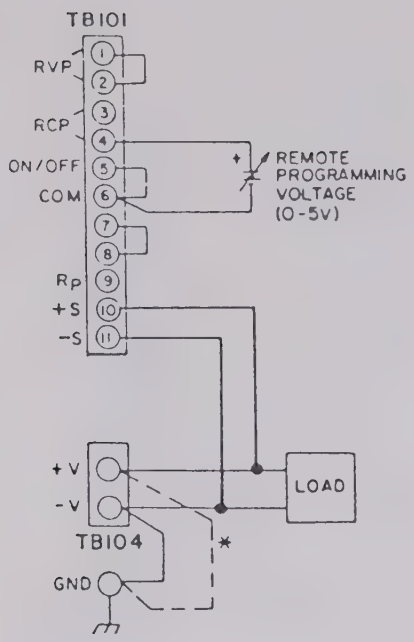
NOTE:
* FOR POSITIVE GROUND, DISCONNECT JUMPER FROM -V TO GND AND RECONNECT FROM +V TO GND.
** A 2.5UF ELECTROLYTIC CAP. MAY BE REQUIRED.

Figure 6. Programmed Voltage Using an External Resistor.



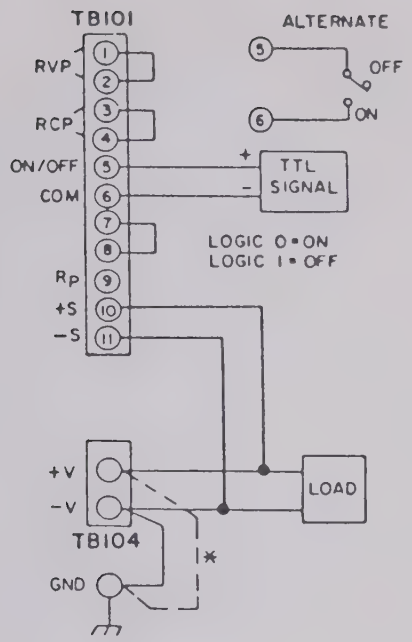
NOTE:
* FOR POSITIVE GROUND, DISCONNECT JUMPER FROM -V TO GND AND RECONNECT FROM +V TO GND.
** A 2.5MF, ELECTROLYTIC CAP. MAY BE REQUIRED.

Figure 7. Programmed Voltage Using an External Voltage Source Referenced to -V.



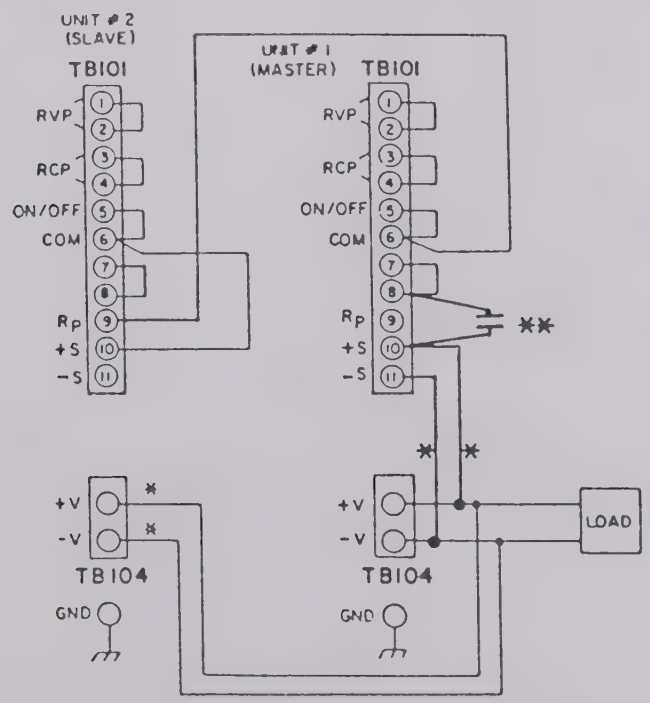
NOTE:
* FOR POSITIVE GROUND, DISCONNECT JUMPER FROM -V TO GND AND RECONNECT FROM +V TO GND.

Figure 8. Programmed Constant Current with a Zero to 5V External Source.



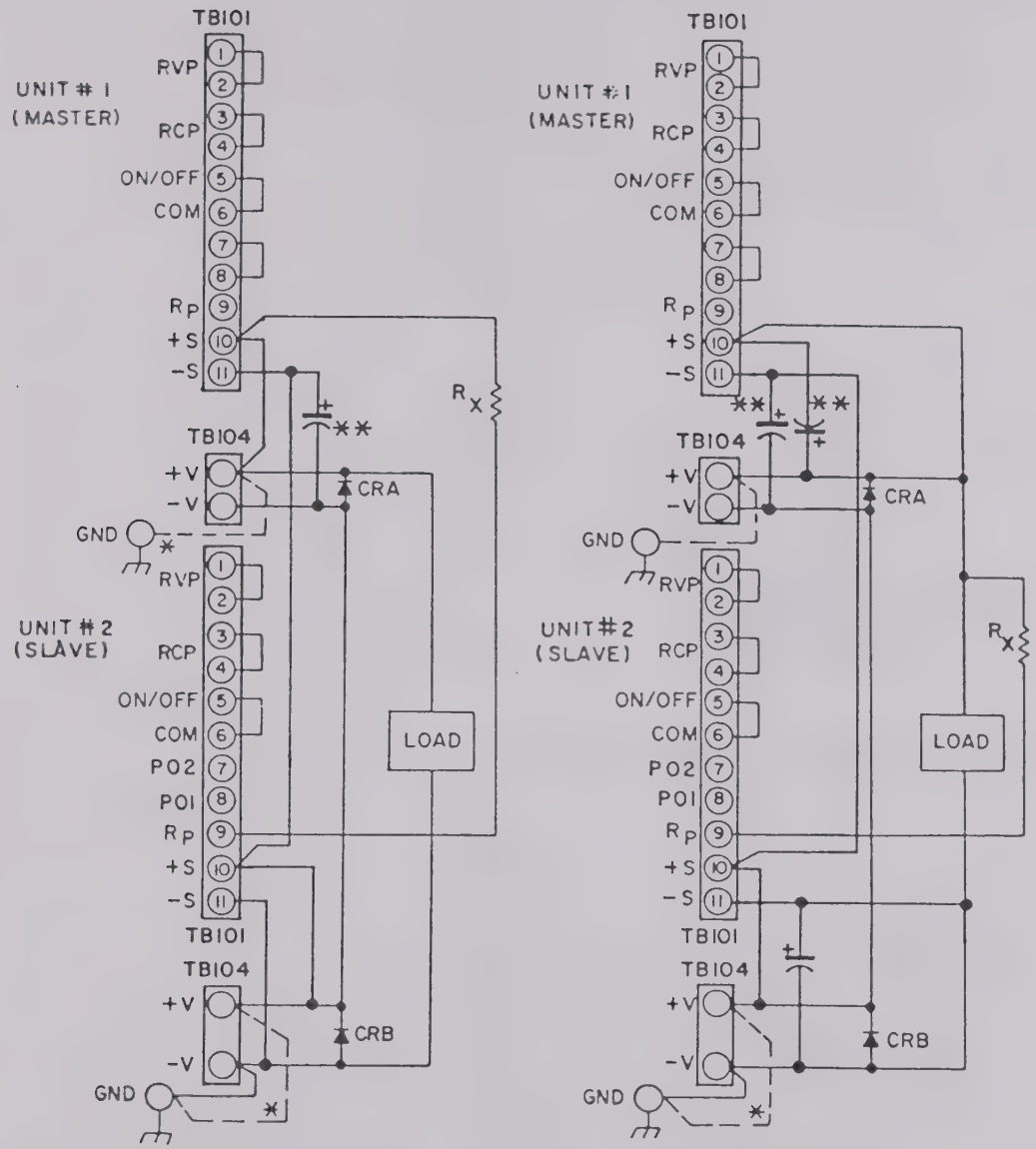
NOTE:
* FOR POSITIVE GROUND, DISCONNECT JUMPER FROM -V TO GND AND RECONNECT FROM +V TO GND.

Figure 9. TTL Compatible Remote On/Off



NOTE: * VOLTAGE DROP ON THESE WIRES SHOULD BE BALANCED TO PROVIDE FOR PROPER CURRENT SHARING.
0.0047UF ÷ 0.1UF MYLAR CAP. MAY BE REQUIRED

** Figure 10. Parallel Operation.



NOTE: * MAKE ONLY ONE GROUND CONNECTION FOR SERIES COMBINATION. TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM -V TO GND AND RECONNECT AS DESIRED.
** A 2.5UF ELECTROLYTIC CAP. MAY BE REQUIRED.

Figure 11. Series Connection.

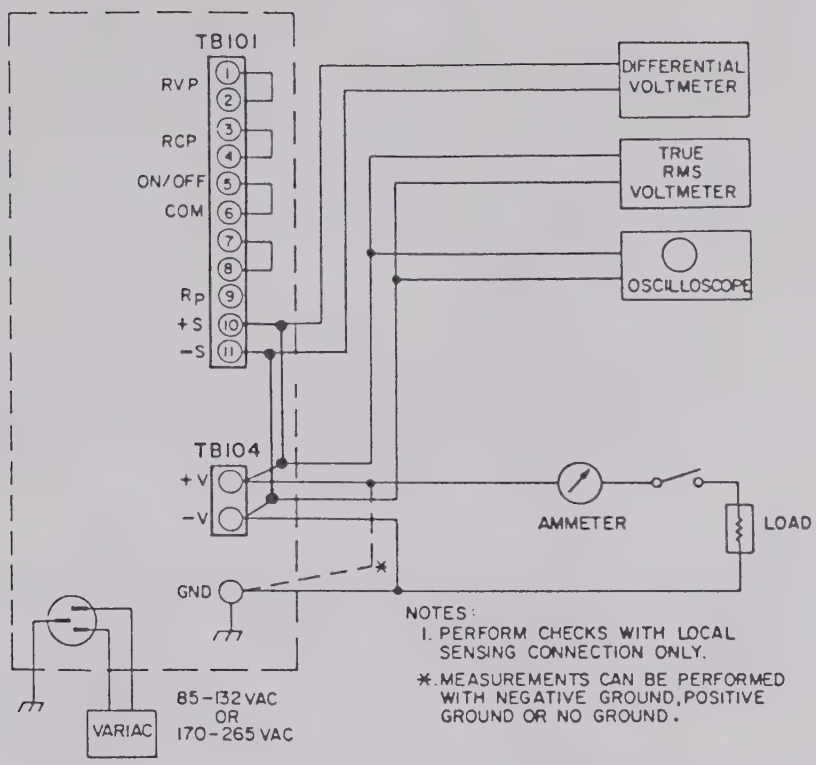


Figure 12. Test Connections for Constant Voltage Performance Checks.

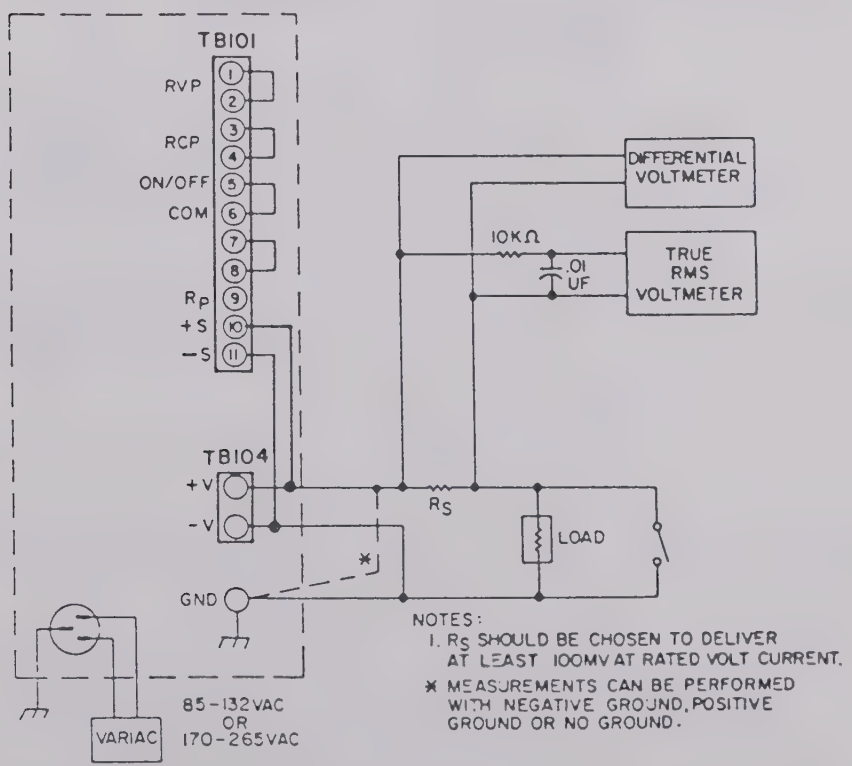


Figure 13. Test Connections for Constant Current Performance Checks.

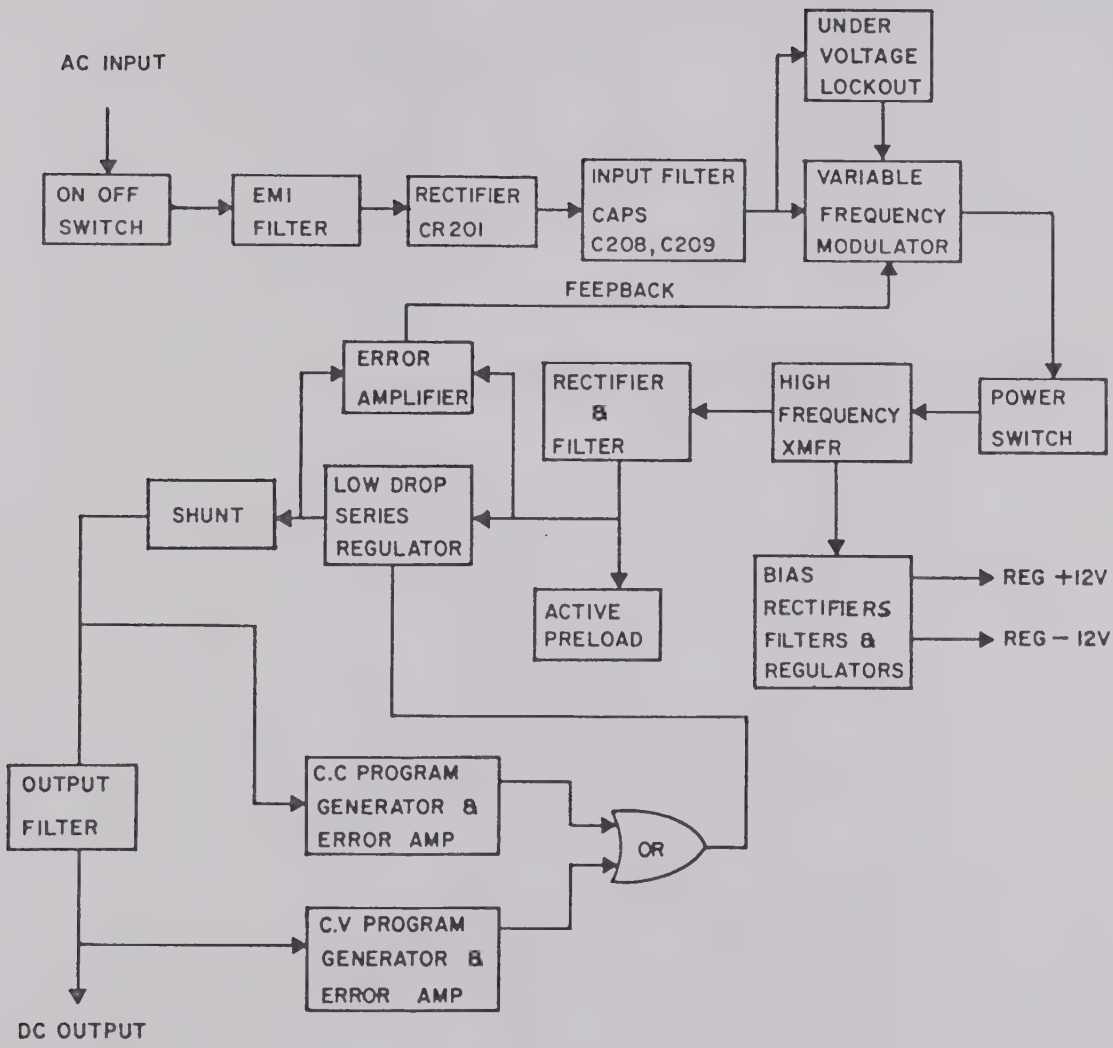
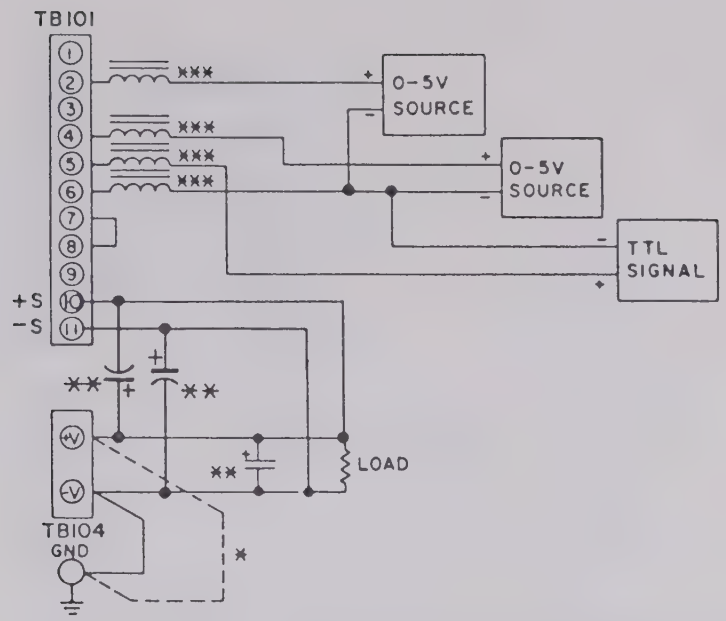
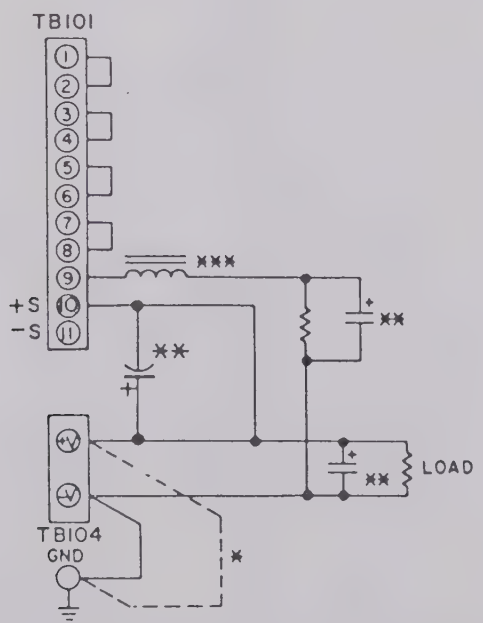


FIGURE 14. BLOCK DIAGRAM



(A) REMOTE VOLTAGE PROGRAMMING (PIN 2), REMOTE CURRENT PROGRAMMING (PIN 4), REMOTE ON/OFF (PINS 5,6), REMOTE SENSE.



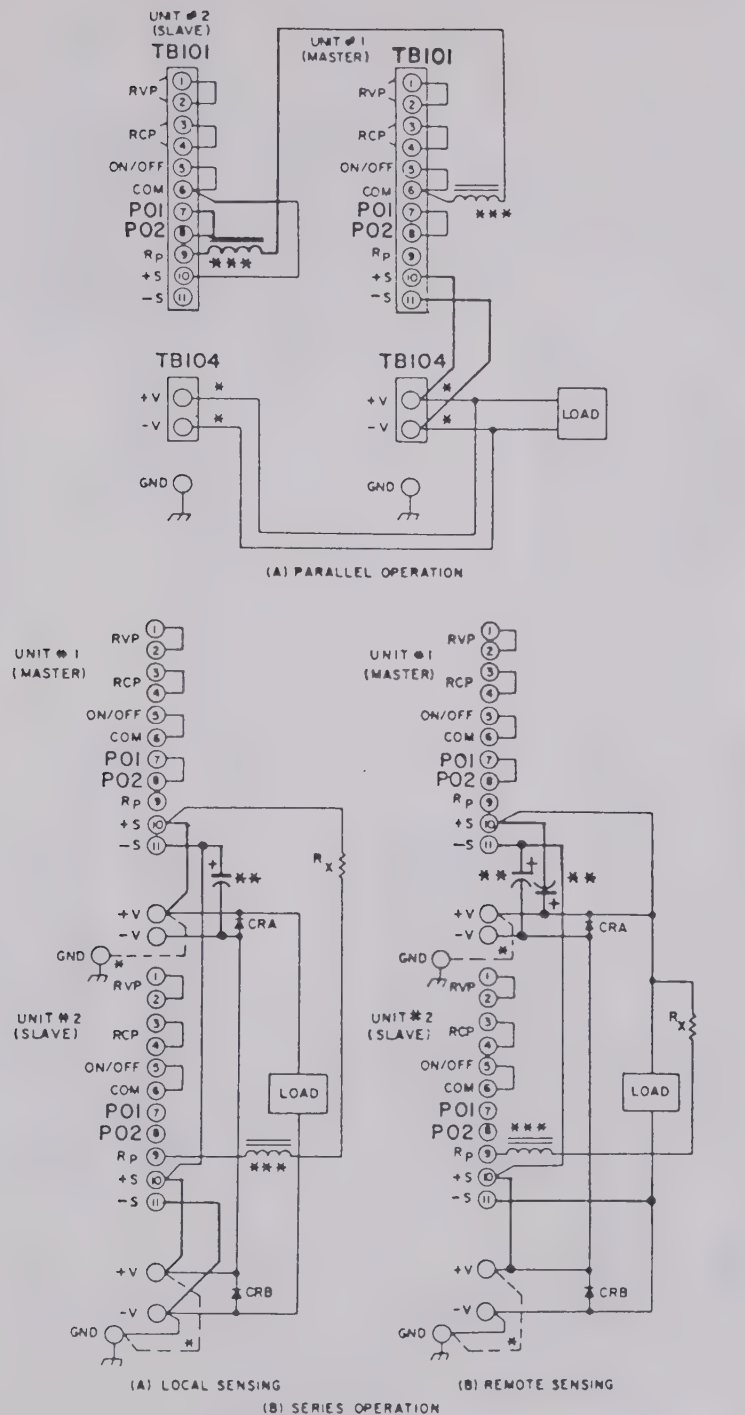
(B) REMOTE RESISTANCE PROGRAMMING (PIN 9), REMOTE SENSE.

NOTE: * FOR POSITIVE GROUND DISCONNECT JUMPER FROM -V TO GND AND RECONNECT FROM +V TO GND.

** A 2.5UF ELECTROLYTIC CAP MAY BE REQUIRED.

*** NOISE SUPPRESSOR IS 8 TURNS ON FAIR RITE PRODUCTS CORP. CORE NO. 5961001103 AND IS CONNECTED WITHIN 3" OF POWER SUPPLY TERMINALS.

Figure 15. Application of Noise Suppressors in Remote Applications Where Extremely Low Noise is Required



NOTE: * MAKE ONLY ONE GROUND CONNECTION FOR SERIES COMBINATION TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM -V TO GND AND RECONNECT AS DESIRED

** A 2 5UF ELECTROLYTIC CAP MAY BE REQUIRED

*** NOISE SUPPRESSOR IS 8 TURNS ON FAIR RITE PRODUCTS CORP CORE NO 5961001103 AND IS CONNECTED WITHIN 3" OF POWER SUPPLY TERMINALS.

Figure 16. Application of Noise Suppressors in Parallel And Series Operation Where Low Noise is Required

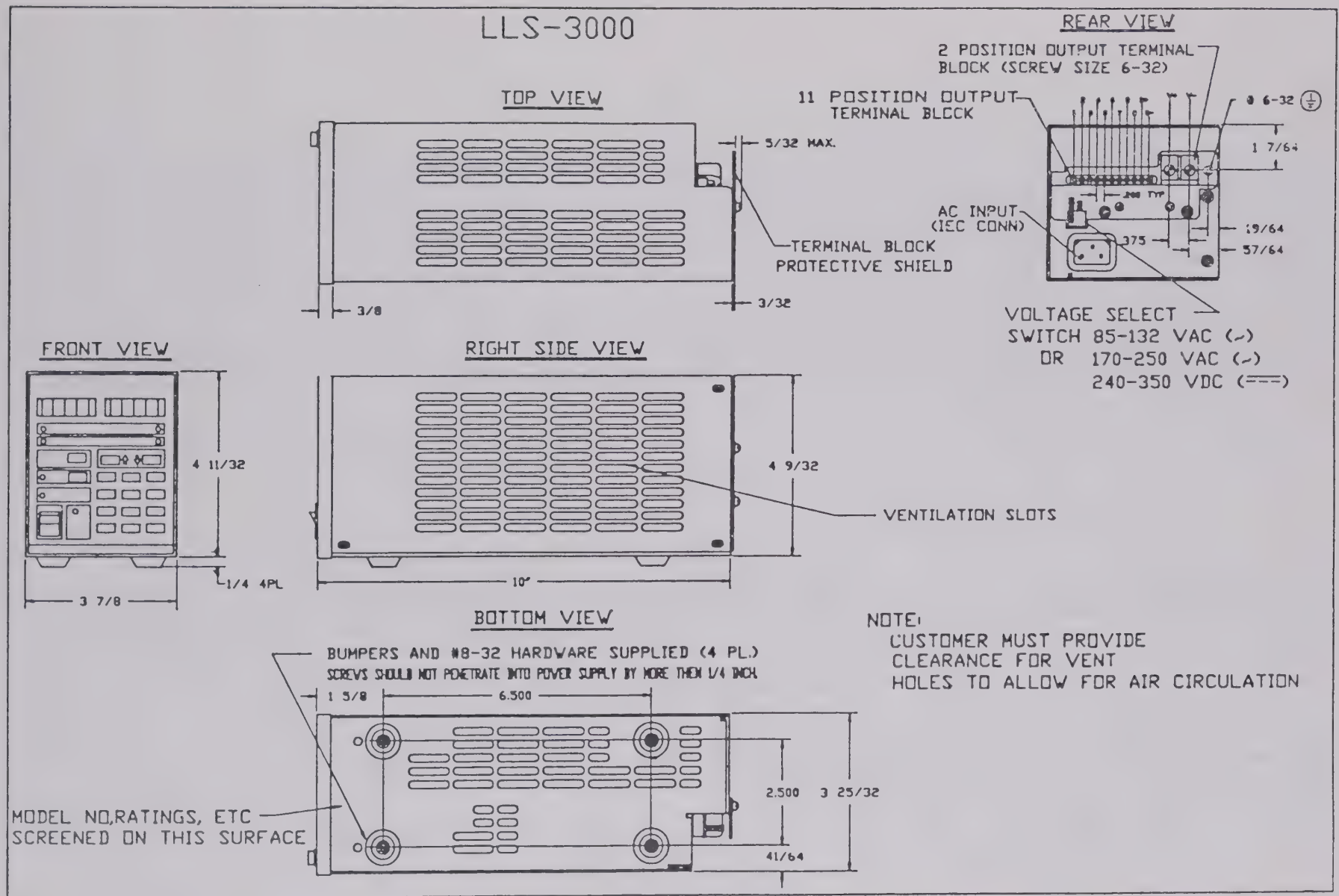


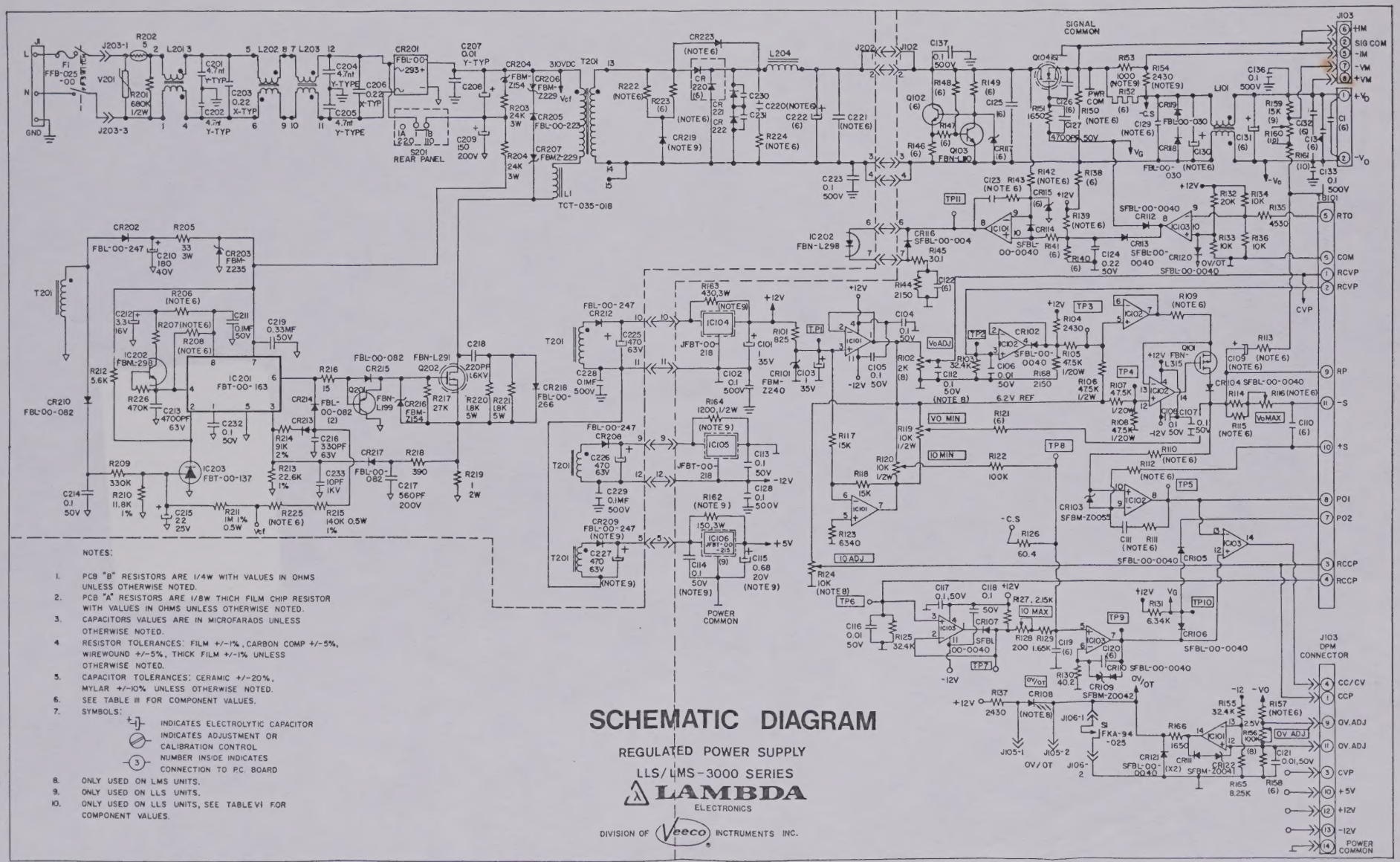
Figure. 17. Outline Drawing

TABLE VI
SCHEMATIC DATA REFERENCES
MODELS LLS-3008 ÷ LLS-3120

MODELS	Schematic Components																					
	C1	C109	CR110, CR125, CR129, CR132, CR134	C111	C119	C120	C122	C123	C126	C130	C131	C220	C221	C222	C230, C231	CR115	CR117	CR219	CR220	CR221 CRZ22	CR223
	±20% CERAMIC		±10% CERAMIC	±20% CERAMIC	±20% CERAMIC	±20% CERAMIC	±20% CERAMIC	±20% CERAMIC	±20% CERAMIC	±20% ELECT	±20% ELECT	CERAMIC	CERAMIC	±20% ELECT	±5% CERAMIC	*FBM-Z	*FBM-Z	*FBL-00-	*FBL-00-	*FBL-00-	*FBL-00-
LLS-3008	0.1mF 100V	ELECT 1mF ±20%, 35V	0.1mF 100V	0.0047mF 50V	0.1mF 50V	0.047mF 50V	0.022mF 50V	0.0047mF 50V	0.022mF 50V	330mF 63V	330mF 63V	±10% 0.0015mF 100V	±10% 0.1mF 100V	2700mF 20V	NOT USED	155	NOT USED	223	258	NOT USED	NOT USED
LLS-3018	0.1mF 100V	ELECT 1mF ±20%, 35V	0.1mF 100V	0.0047mF 50V	0.1mF 50V	0.1mF 50V	0.022mF 50V	0.0047mF 50V	0.022mF 50V	330mF 63V	330mF 63V	±20% 0.001mF 1KV	±10% 0.1mF 100V	1500mF 40V	NOT USED	155	NOT USED	223	282	NOT USED	NOT USED
LLS-3040	0.1mF 100V	ELECT 1mF ±20%, 200V	0.1mF 100V	0.01mF 50V	0.22mF 50V	0.22mF 50V	0.068mF 50V	0.0068mF 50V	0.022mF 50V	330mF 63V	180mF 60V	±20% 240pF 1KV	±10% 0.1mF 100V	470mF 75V	NOT USED	155	NOT USED	223	282	NOT USED	NOT USED
LLS-3060	0.1mF 100V	ELECT 1mF ±20%, 200V	0.1mF 100V	0.0047mF 50V	0.22mF 50V	0.22mF 50V	0.068mF 50V	0.01mF 50V	0.01mF 50V	68mF 100V	68mF 100V	±20% 240pF 1KV	-20+80% 0.1mF 500V	330mF 100V	10pF 1000V	154	167	223	NOT USED	247	269
LLS-3120	0.068mF 200V	ELECT 1mF ±20%, 200V	0.0068mF 200V	0.01mF 50V	NOT USED	0.1mF 50V	0.22mF 50V	0.0033mF 50V	0.047mF 50V	27mF 200V	27mF 200V	±5% 18pF 1KV	-20+80% 0.1mF 500V	150mF 200V	10pF 1000V	167	167	266	NOT USED	223	257

MODELS	Schematic Components																												
	R109	R110, R112	R111	R113	R114	R115	R116	R121	R138	R139	R140	R141, R142	R143	R146	R147	R148	R149	R150	R152	R157	R158	R160	R161	R206	R207	R208	R222, R223	R224	R225	Q102	Q104
	±1% 1/8W	±1% 1/8W	±1% 1/8W	±1% 1/8W	±1% 1/2W	±1% 1/2W FILM	±10% 1/4W FILM	±1% 1/8W	±1% 1/8W	±1% 1/8W	±1% 1/8W	±1% 1/8W	±1% 1/8W	±5% 1/4W CARB	±5% 1/4W CARB	±5% 1/2W CARB	±5% 3W OXIDE	±5% 3W OXIDE	±1% 3W WW	±1% 1/8W	±1% 1/8W	±10% 1/4W VAR	±1% 1/8W	±5% 1/4W CARB	±1% 1/4W FILM	1/4W	±5% 5W WW	±5% 3W OXIDE	±1% 1/2W FILM	*FBN-L	*FBN-L
LLS-3008	499	2.43K	22.1K	40.2	1.54K	NOT USED	200	619K	619K	6.34K	604	4.99K	200K	2.2	100	820	82	82	0.05	16.9K	30.9K	10K	6.34K	150	±5% 147K	±5% 15K CARB	110	33	121K	279	238
LLS-3018	499	2.43K	32.4K	40.2	3.24K	NOT USED	1K	619K	619K	4.53K	604	8.25K	200K	5.6	68	18K	360	430	0.11	6.19K	11K	10K	32.4K	150	1.4K	±5% 15K CARB	350	82	121K	279	238
LLS-3040	499	825	15K	40.2	7.5K	NOT USED	1K	619K	1.8M	4.53K	2.43K	20K	200K	12	100	7.5K	2.4K	1.5K	0.25	10.5K	5.36K	50K	100K	180	1.4K	±5% 15K CARB	1.8K	750	140K	279	277
LLS-3060	499	825	32.4K	100	22.1K	22.1K	2K	619K	1.8M	4.53K	6.34K	20K	110K	15	1.2K	150K	5.6K	3.6K	0.35	7.5K	3.65K	100K	110K	150	1.58K	±1% 16.9K FILM	5.5K	18K	140K	270	277
LLS-3120	1K	4.99K	32.4K	100	90.9K	90.9K	5K	1.8M	1.8M	4.99K	15K	20K	110K	24	1K	270K	12K	12K	0.7	11.8K	1.82K	100K	301K	150	1.4K	±1% 18.2K FILM	20K	2.4K	121K	293	316

*LAMBDA PART NUMBER



NOTES:

1. PCB "B" RESISTORS ARE 1/4W WITH VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. PCB "A" RESISTORS ARE 1/8W THICH FILM CHIP RESISTOR WITH VALUES IN OHMS UNLESS OTHERWISE NOTED.
3. CAPACITORS VALUES ARE IN MICROFARADS UNLESS OTHERWISE NOTED.
4. RESISTOR TOLERANCES: FILM +/-1%, CARBON COMP +/-5%, WIREWOUND +/-5%, THICK FILM +/-1% UNLESS OTHERWISE NOTED.
5. CAPACITOR TOLERANCES: CERAMIC +/-20%, MYLAR +/-10% UNLESS OTHERWISE NOTED.
6. SEE TABLE III FOR COMPONENT VALUES.
7. SYMBOLS:
   - +|- INDICATES ELECTROLYTIC CAPACITOR
   - INDICATES ADJUSTMENT OR CALIBRATION CONTROL
   - (3) NUMBER INSIDE INDICATES CONNECTION TO P.C. BOARD
8. ONLY USED ON LMS UNITS.
9. ONLY USED ON LLS UNITS.
10. ONLY USED ON LLS UNITS, SEE TABLE VI FOR COMPONENT VALUES.

SCHEMATIC DIAGRAM

REGULATED POWER SUPPLY

LLS/LMS-3000 SERIES

LAMBDA ELECTRONICS

DIVISION OF Veeco INSTRUMENTS INC.

MP MASTER
MA28684